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ATLAS OF SUITABLE GRAPE GROWING LOCATIONS

IN THE OKANAGAN AND SIMILKAMEEN VALLEYS OF BRITISH COLUMBIA

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ATLAS OF SUITABLE GRAPE GROWING LOCATIONS

IN THE OKANAGAN AND SIMILKAMEEN VALLEYS OF BRITISH COLUMBIA

ASSOCIATION OF BRITISH COLUMBIA
GRAPE GROWERS

MAP COLLECTION
UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA
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1984

TECHNICAL CONTRIBUTORS

R. Davis, P. Ag.	–	Head, Climatology Unit, British Columbia Ministry of Environment
R. Chilton	–	Climatologist, Private Consultant
L. Ottenbreit	-	Cartographer, Vision-L, Private Consultant
M. Scheeler, P. Ag.	–	Pedologist, Agricultural Appraisals, Private Consultant
J. Vielvoye, P. Ag.	–	Project Co-ordinator, Provincial Grape Specialist, British Columbia Ministry of Agriculture and Food
R. Williams, P. Ag.	–	Agricultural Climatologist, Ministry of Environment
U. Wittneben, P. Ag.	–	Pedologist, British Columbia Ministry of Environment

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Soil Science and Agricultural Engineering
Agriculture Canada
Research Station
Summerland, British Columbia
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Canada

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HISTORICAL PHOTO. Wine Grape Harvest

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INTRODUCTION

The purpose of this Atlas is to identify land areas in the Okanagan and Similkameen Valleys of British Columbia that have a growing season climate (excludes winter months) and soil characteristics suitable for grape production.

This information is presented through the use of diagrams, maps, tables and written information. Users are encouraged to read all of the narratives before referring to the maps. These narratives outline important details that may not be presented elsewhere.

No specific recommendations for cultural or management practices are made in this atlas, but broad comments are made that could influence some climate or soil conditions. Users who wish specific recommendations are advised to refer to other publications. Local representatives of the British Columbia Ministry of Agriculture and Food are available for consultation on specific farm management decisions. British Columbia Ministry of Environment, Fish and Wildlife officers are available for consultation regarding the probabilities of wildlife conflicts in areas where overwintering ranges for deer or other wildlife exist. These conflict areas exist on all lower slopes and terraces, particularly those with southern or south-western exposures.

A glossary is provided to help users understand some of the terminology that is used. A list of references is also provided.

The Atlas provides information in several sections, each dealing with a particular theme. The section on climate deals with themes on solar radiation, growing degree days, autumn freeze risk and winter damage. This information is presented as maps, tables, diagrams and in written form. Tables are designed to permit users to calculate the risk of certain events. Winter damage to vines and low winter temperatures have historically been erratic. Damage to vines during the winter months has also been influenced by adverse management practices. A map of winter damage was not developed for these reasons. A tabular presentation of winter temperature risk for various areas is presented instead.

The section on soils deals with themes of soil development, glaciation, soil properties and soil groups. Soil maps in the atlas were produced by grouping soils with physically similar characteristics. These soil groups are presented in tabular form. Some diversification within these groupings can be expected. These maps are therefore not a substitute for proper soil sampling and analysis. Management practices that could alter the classification placed on a soil were discussed but have not been taken into consideration in these classifications. Detailed soil maps for the atlas area are available from the British Columbia Ministry of Environment.

The section on grape production deals with historical and current trends, and provides information on grape varieties and sites suitable for grape production. Tables and maps are used to present this information. The grape variety suitability table is not complete as many varieties are still under evaluation. It does, however, identify suitable areas for many commercial varieties at the time of publication.

The site suitability maps were developed by overlaying all the climate and soil themes. Boundaries in some map units may at times appear abrupt as a result of this procedure. These maps are not a substitute for sound reasoning and observation. They are a guideline to site selection. The scale of mapping used (1:50,000) allows for a fairly detailed presentation of topography. However, the scale is too small to allow detailed analysis of climate and soil for each farm parcel. Individual farms have variations in soil, topography, aspect, elevation and vine training.

In this map area, much still needs to be learned about the environmental influences on grape production. The choice of a proper site, together with suitable varieties is a decisive question for grape growers. This atlas will provide assistance in that important decision.

HISTORICAL PHOTO. Pioneers test new variety

1. HISTORICAL PROGRESSION

Grape plants have been grown in many areas of British Columbia. Early explorers and settlers brought grape plants or cuttings with them, or imported grape varieties from other countries.

The development of a grape growing industry in British Columbia during the 1930's to the 1950's was centered in the Fraser Valley and Okanagan Valley. Grape production has since declined in the Fraser Valley and expanded in the Atlas area.

Within this area, the earliest record of a serious attempt at grape production appears to have been made in 1907 by Mr. W.J. Wilcox of Salmon Arm. The Wilcox planting consisted of 0.3 hectares (3/4 acre) of North American varieties such as Concord, Campbell's Early, Moore's Worden, Niagara, Green Mountain, White Diamond, Brighton and Delaware. Some of these varieties, and others planted in 1928, have suffered damage from cold winters. Some recovered and are still in production today.

Many different types of grape varieties were planted during these early years. Most were planted without any advice of suitability for the area, markets or winter hardiness. Consequently, a wide range of varieties were grown, based on whatever was grown elsewhere, such as Eastern Canada, United States or Europe. Many plantings failed due to a lack of irrigation, unfavourable climate or unfavourable soils. These areas have, over the years, reverted to other land uses. Valley bottoms, for example, developed into dairy, forage or vegetable growing areas.

The first successful large vineyards were planted in the Kelowna area by Mr. J.W. Hughes in 1926, with cuttings he obtained from the Wilcox planting and others. Mr. Hughes also planted a vineyard on Black Mountain, near Kelowna. This planting later failed. By 1930, he had planted 49 hectares (125 acres). Another 29.5 hectares (75 acres) were planted in 1939. Other people, also, planted grapes. They were generally small acreages. Many of these depended on Mr. Hughes to market their crop.

Amongst those others were brothers, Virgil J. and Eugene A. Rittich who brought 40 grape varieties from Europe. After 10 years of evaluations of these and other varieties on Black Mountain and in the Ellison area near Kelowna, they recommended the planting of Perle of Csaba, Muscat Ottonel, Riesling, Sylvaner, Muscat Ferdinand de Lessepe, Blue and White Burgunder, Siebel 5279, White and Red Chasselas, Sylvaner and Excellent. Of these, Perle of Csaba, Muscat Ottonel and Siebel 5279 (now know as Aurora) are still grown in small quantities in the area today.

A small planting was established by Mr. E. Rittich at the home of Mr. J. Renyi in Oliver in 1936. It is believed that Okanagan Riesling spread to the existing grape industry from that planting. Still another planting was made in Vernon, at the farm of Mr. Norley F. Tunbridge. This planting apparently did not do well and was removed.

Through the efforts of pioneers such as Mr. J.W. Hughes, the Rittich brothers and others, grape acreage gradually increased. Extensive experimentation at the Agriculture Canada Research Station at Summerland (known as the Dominion Experimental Farm at that time) fostered the development of the fledgling industry. By 1947 the station had tested 112 grape varieties. Most of them were eliminated because of tenderness or extreme susceptibility to powdery mildew. Some of them were:

Black Burgundy
Black Hamburg
Black Muscat
Cabernet Sauvignon
Excellent (Ezerjo)
Furmint

Gewurztraminer
Muscat F. de Lessepe
Muscat Angevine
Rauschling
Ribier
Semillon

Thompson Seedless
Tinta Madeira
Valdepenas
Vergennes
Yates

Varieties that were recommended for planting at that time included the following:

Table 1
Early Varieties

Home Use	Restricted Commerical Or Winery	General Use
Agawam	Blue Burgunder	Campbell Early
Beta	(Blau Frankisch)	Concord
Clinton	Clinton	Delaware
Delaware	Delaware	Patricia
Eden	White Diamond	Sheridan
Herbert	Golden Chasselas	
Ontario	Niagara	
Pearl of Csaba	Ontario	
Sheridan	Pearl of Csaba	
	Siebel 5279	
	Sheridan	
	White Burgunder	

Interest in wine grapes grew in the 1930's because:

1) two commercial wineries requested grapes for wine making;
2) there were adverse market conditions for apples;
3) of expectations of stable markets for grapes;
4) of early production, lower levels of management required when compared to tree fruit production;
5) of development of superior varieties;
6) of potential for mechanical harvesting.

Slowly, but gradually, during the latter part of the 1950's, experimentation again began with non traditional varieties. Word from Ontario about French Hybrids, suitable for colder areas and resistant to disease, encouragd several grape growers and researchers to import small quantities of many such varieties.

By 1952, there were 120 hectares (425 acres) of vineyards in the Okanagan, mostly around Kelowna. Varieties planted were still the native North American types, mainly because the more difficult to grow European grapes were not winter hardy, were more prone to disease, cost more to produce and were valued at the same price as hardier and disease resistant varieties such as White Diamond and Campbell Early.

By 1959, word spread that these varieties produced good wine. Several plantings were made at Cawston, Westbank, Summerland and Kelowna. In 1964, the climatic potential of the Oliver area was tested with the planting of the first of what would become a succession of large vineyards located on very sandy soil. Grape area by 1966 totalled 753 hectares (1,912 acres). Of this, 280 hectares (711 acres) were more than four years old. The grape industry had entered a period of consolidation when new acreages were just coming into production and present and prospective growers were assessing the success of their ventures from current vineyard performance before expanding grape production. By 1974, the total grape plantings had increased to 1241 hectares (3,066 acres). The planting of grape varieties during this period proliferated and retracted. Since 1974 there has been a resurgence of interest in newer grape varieties. Attempts to grow European type grapes from California have been unsuccessful in this area. Despite this historical knowledge, attempts are continually made to grow such grapes. Promotion of the V. vinifera species in 1974 led to large importations of various varieties of this species from California and Washington. Most of these plantings were killed in the winter of 1978-79. Several hybrid grape plantings were severely damaged during this winter. They have recovered or were replanted and are in production again today. The planting of north European selections of V. vinifera has taken place after 1978. Some of these selections appear to have promise, but the absence of a cold winter since 1979 has prevented the evaluation of their hardiness. Such winters have historically occurred approximately every seven years (1894, 1909, 1915-16, 1924-1925, 1930-31, 1935-36, 1949-50, 1955-56, 1964-65, 1968-69, 1972-73, 1978-79). Site selection, management practices and variety selection have proven to be the key to winter survival. Despite these severe winters, the interest in grape production has continued to grow.

Table 2
Total Hectares (Acres) of Grapes Planted
in the Okanagan and Similkameen Valleys

Year	Hectares	(Acreage)
1952	172	(425)
1964	480	(1,187)
1970	977	(2,414)
1972	1,093	(2,702)
1974	1,241	(3,066)
1979	1,310	(3,236)
1982	1,223	(3,022)

1.1 CURRENT AND FUTURE PROSPECTS

The 1980's should be a period of extensive varietal experimentation followed by a period of sorting and evaluation. New and improved wine making and fresh market grape varieties have been produced through a breeding program at the Agriculture Canada Research Station at Summerland. These varieties, as well as ones from evaluation plantings consisting of imported north European varieties, new French hybrids, varieties from the breeding program of the Ontario Ministry of Agriculture and Food and from the United States will eventually form a base for the continued growth in the commercial grape industry. With these new varieties will come the technological innovations, improved cultural practices and better pest control methods that will all contribute greatly to successful vineyard operations. Productivity has increased from historical yields (1952-1970) of 10.64 tonnes/h (4.75 tons/ac) to 11.04 tonnes/h (4.93 tons/ac) during 1970-1978.

Table 3
Average Production per Hectare (Ton/Acre)
in the Okanagan and Similkameen Valleys

District	1970	1972	1974	1978	Average
	Tonnes per hectare (Tons/Acre)				
Winfield North	16 (7)	5 (2)	6 (3)	11 (5)	9 (4)
Kelowna	11 (5)	11 (5)	19 (9)	19 (9)	15 (7)
Westbank	15 (7)	7 (3)	9 (4)	13 (6)	11 (5)
Peachland, Summerland	10 (5)	10 (4)	9 (4)	9 (4)	9 (4)
Penticton, Naramata, Okanagan Falls and Similkameen Valley	6 (3)	11 (5)	13 (6)	15 (7)	11 (5)
Oliver-Osoyoos	5 (2)	12 (6)	9 (4)	15 (6)	10 (5)
Averages	10.5(4.8)	9.3(4.2)	10.8(5)	13.7(6.2)	10.8(5)

Production techniques involving trellising, irrigation and cultural practices are in a stage of change. Traditional Kniffen trellising (two and three wire) has been replaced largely by the more productive T-Bar system. Newer trellising methods specifically designed for vigorous grape varieties hold promise of greater yields while varieties suitable for cordon training and the European loop system respond by increasing yields when they are trained to these systems. These productivity gains will have beneficial effects on the high costs of grape growing.

Grape production records are available from the year 1930 onwards. In that year, 122 tonnes (136 tons) of grapes were produced. The largest tonnage between 1930 and 1961 was produced in 1944 and amounted to 1469 tonnes (1,632 tons). The period between 1944 and 1960 had an average production of 605 tonnes (675 tons), with the exception of 1956, when only 195 tonnes (217 tons) were produced. By 1950, only 60 percent of the total crop was sold as fresh fruit. This percentage declined further to 39 percent by 1959, a reflection of the growing demand for grapes by British Columbia wineries at that time, and the competitive returns provided by the two existing markets. Production since 1960 is presented in Table 4, additional information pertaining to grape varieties, grape producing areas and types of grapes planted are presented in Tables 5, 6, 7 and 8.

Table 4
Total Grape Production in the
Okanagan and Similkameen Valleys

Year	Tonnes	Tons	Value $	% of Total Crop Sold As: Fresh Fruit	% of Total Crop Sold As: Fruit For Processing
1960	598	(634)	80,535	33	67
1961	1,605	(1,783)	261,850	21	79
1962	1,498	(1,665)	238,007	36	64
1963	1,845	(2,050)	251,500	8	92
1964	2,583	(2,870)	372,933	10	90
1965	167	(185)	26,280	14	86
1966	2,701	(3,001)	396,510	11	89
1967	3,359	(3,733)	525,778	13	87
1968	5,546	(6,162)	835,294	8	92
1969	1,543	(1,714)	242,038	6	94
1970	8,134	(9,038)	1,481,118	5	95
1971	8,197	(9,107)	1,568,428	6	94
1972	9,025	(10,028)	2,042,441	6	94
1973	5,764	(6,404)	1,428,694	11	89
1974	10,928	(12,142)	3,383,315	6	94
1975	11,300	(12,589)	3,952,765	7	93
1976	11,410	(12,678)	3,735,077	8	92
1977	10,542	(11,713)	3,859,583	11	89
1978	16,564	(18,404)	6,410,062	6	94
1979	9,393	(10,437)	4,307,116	9	91
1980	12,379	(13,755)	6,335,157	6	94
1981	10,507	(11,674)	5,808,468	6	94
1982	14,066	(15,629)	8,699,838	4	96

Table 5
The 12 Most Important Grape Varieties
(and Groupings) Produced in the Okanagan
and Similkameen Valleys in 1982

Variety	Type of Grape	Color	% of Total Production	% of Total Hectares (Acreage)
Marshall Foch	Hybrid	Blue	25	19
De Chaunac (S-9549)	Hybrid	Blue	22	16
Okanagan Riesling	unknown	White	21	25
Verdelet (S-9110)	Hybrid	White	5	8
Rougeon (S-5898)	Hybrid	Blue	5	4
White Diamond	V. labrusca	White	4	6
Fresh Market	V. labrusca	Blue	4	1.5
Johannisberg Riesling	V. vinifera	White	2	3
Chelois (S-10878)	Hybrid	Blue	1.5	2
Rosette (S-1000)	Hybrid	Blue	1.5	1
Bath	Hybrid	Blue	1.3	1
Ehrenfelser	V. vinifera	White	1	1.5

Table 6
Some of the Less Important Grape Varieties
Produced in the Okanagan and
Similkameen Valleys in 1982

Variety	Type of Grape	Color	% of Total Production	% of Total Hectares (Acreage)
Delaware	Hybrid	Pink	0.7	1
Chancellor (S-7053)	Hybrid	Blue	0.6	1
Aurora (S-5279)	Hybrid	White	0.6	1
Baco Noir	Hybrid	Blue	0.5	1
Himrod	Hybrid	White	0.5	1
Gewurztraminer	V. vinifera	Pink	0.3	1
Chenin Blanc	V. vinifera	White	0.3	1
All others			3.5	6

Table 7
Percentages of Grape Production by District

District	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Oliver-Osoyoos	42	38	38	27	36	42	44	43	27	33	33	38
Penticton, Naramata, Okanagan Falls and Similkameen Valley	4	8	2	6	5	9	7	8	7	7	8	8
Summerland, Peachland	4	4	4	4	5	4	3	3	3	3	4	4
Westbank	9	12	17	15	14	12	10	11	16	14	12	12
Kelowna	39	35	33	45	34	28	31	31	40	37	35	30
Winfield North	2	3	6	3	6	5	5	4	7	6	8	8

Table 8
Total Grape Area Planted and the Percentage
of Area Occupied by Type of Grape

Grape Type	1974 Total Hectares (Acreage)	1974 Percent of Total	1979 Total Hectares (Acreage)	1979 Percent of Total	1982 Total Hectares (Acreage)	1982 Percent of Total
Direct Producers (French Hybrids)	618(1,527)	50	677(1,673)	52	668(1,650)	55
Other Hybrids	355 (878)	28	320 (792)	24	305 (753)	24
V. labrusca	250 (618)	20	191 (473)	15	168 (415)	14
V. vinifera	18 (44)	2	121 (298)	9	82 (204)	7
TOTAL:	1,241(3,067)	100	1,309(3,236)	100	1,223(3,022)	100

1.2 VINEYARD ESTABLISHMENT AND PRODUCTION COST

Establishment and production costs of a commercial vineyard are always difficult to determine. The availability and cost of suitable land on suitable sites, equipment, supplies and interest charges make grape growing a high cost enterprise. Influences of market demand for specific varieties changes, as does the technology of vine spacing, trellising, cultural practices and pest control. These factors together with uncertainty produced by climate, also contribute to make grape growing a high risk enterprise.

Studies in 1982 show that the cash cost of establishing a vineyard of this size in 3 years range from $107,092 to $180,497 and maintenance cost for such a vineyard range from $30,875 to $31,544. Breakdown of these costs are given in Table 9.

Table 9
Relative Cost of Various Items that affect
the Accumulated Costs of Establishing and
Maintaining a Mature 8.7 Hectares
(21.5 Acre) Vineyard

Items	Approximate Percentage of Total Cash Cost: Establishment	Production
Fertilizer	1	0.5 - 1.4
Plants	6 - 15	-
Fungicide	1 - 2	- 3.0
Water	1 - 2	1.5 2.0
Machine rental	1 - 2	7 - 0.1
Other supply and services (trellis, material, harvest cost)	10 - 13	0.1 - 0.5
Tractor operating cost	4 - 5	- 5.0
Machinery operating cost	4 - 5	4.0 - 4.5
Hired labour	12 - 13	- 10.0
Cash overhead (insurance, telephone, electric power, accounting)	2 - 2	2.5
Marketing fee	0.5	1
Custom work	2	10 - 13
Total cash cost	50 - 60	40 - 45

Additional costs to consider are interest on operating capital, depreciation (building, equipment), interest on investment and operator labour value.

The major pieces of equipment used on the average 8.7 hectares (21.5 acre) vineyard are listed in Table 10.

Table 10
Costs of Equipment and Buildings

		Approximate Cost (New - 1982)
1.	Tractor - 50 H.P. (Diesel)	$16,400
2.	Front end loader and forks	3,300
3.	Disc - seven foot	1,500
4.	Cultivator - seven foot	700
5.	Grape hoe	5,000
6.	Fertilizer spreader	900
7.	Sprayer - 100 gallons	4,200
8.	Irrigation system	33,000
9.	Truck - 1.2 ton (used)	7,600
10.	Grape trimmer	1,500
11.	Rear fork lift	200
12.	Bird alarm	900
13.	Pruning sweep	400
14.	Small tools and equipment	1,020
15.	Storage shed (1,000 square feet)	8,100

Other equipment that could be used from time to time include tractor mounted soil auger, post pounder, wire reel or compressors. These pieces of equipment, as well as the ones listed above, may be rented or could be used on a custom basis. The hours of actual use of any piece of equipment is a factor considered whether it is rented or purchased.

1.3 GRAPE MARKETING

The marketing of grapes involves several distinctly different marketing systems. In this presentation, the added value of the grapes as they move through the marketing channels is not taken into consideration.

Most of the grapes produced in the Okanagan and Similkameen Valleys are purchased by wineries located in British Columbia. The marketing of these grapes is governed by the actions of agencies such as the Association of British Columbia Grape Growers, Grape Marketing Board, Grape and Wine Institute, Provincial Ministries of Consumer and Corporate Affairs and Agriculture and Food.

The Grape Marketing Board came into existence in 1970, after a plebiscite by established grape growers requested its formation under the Natural Products Marketing (British Columbia) Act. The Board derived its' powers as a marketing board through this act and the British Columbia Grape Marketing Scheme. Prior to the Board's formation, wineries negotiated directly with producers for their grapes. Increased demand for wine, and a demand for higher grape prices, led to the formation of the Grape Marketing Board.

Under this marketing system, any person who owns three acres or more of grapes that are offered for sale to wineries must register with the Grape Marketing Board. Any winery that offers to buy grapes must buy grapes only from producers who are registered with the Marketing Board. The Board issues, to registered producers, a license to sell grapes to wineries. The Board establishes the prices that are paid for grapes on a per ton basis, and a quality standard that is based on the soluble solids content of grapes in the field, through a negotiating process with wineries.

Membership on the Board consists of five grape growers elected by registered producers. Appeals to a decision of the Board may be made to the British Columbia Marketing Board. This Board consists of five members appointed by the British Columbia Ministry of Agriculture and Food. These members do not include grape growers or winery representatives, but may include representation from other agricultural or non agricultural backgrounds.

The Ministry of Consumer and Corporate Affairs, through its regulatory authority, and the Ministry of Agriculture and Food, through it's Legislative authority and it's extension and research programs, have established policies of support for the development of both the wine and grape producing industries in the province.

The Ministry of Consumer and Corporate Affairs regulates the importation of grape production shortfalls by grape growers and regulates the marketing of all alcoholic products. The total capacity of wineries in British Columbia is given in Table 11.

Table 11
Wineries in British Columbia and their
Total Capacity in Gallons (1983)

	Winery	Total Capacity (1983)
1.	Andres Wines Ltd.	2,600,000
2.	Brights' Wines Ltd.	800,000
3.	Calona Wines Ltd.	4,600,000
4.	Casabello Wines Ltd.	2,400,000
5.	Claremont Estate Wines	60,000
6.	Devino Estate Wines	40,000
7.	Gray Monk Estate Wines	16,000
8.	Mission Hill Vineyards Ltd.	600,000
9.	Beaupre Wines	120,000
10.	St. Michelle Wines (Jordan Cellars)	4,000,000
11.	Sumac Ridge Estate Wines	40,000
12.	Uniacke Estate Wines	17,000

Marketing of British Columbia table grapes is less complicated. Prior to the existing fresh grape marketing system, fresh grapes were marketed directly from vineyards to retailers, via brokerage firms in larger centers. Grapes were sold in British Columbia, Alberta, Saskatchewan and Manitoba in six quart baskets. Shipments were made by railway. More recently, the Association of British Columbia Grape Growers, through its Basket Committee, organizes the harvest; the delivery of packaged baskets to centrally located tree fruit packing houses and the payment for these grapes via British Columbia Tree Fruits Ltd. Sales of grapes and the delivery to market are a responsibility assigned to this latter agency. A pooling system exists, whereby the returns paid for grapes and costs incurred in marketing are considered before payment to producers is made.

The marketing system for fresh grapes is not controlled by the Grape Marketing Board and sales via British Columbia Tree Fruits Ltd. are on a voluntary basis. Direct marketing from vineyards to retailers and wholesalers can still take place.

Harvest costs and changing consumer demand have resulted in a sharp reduction of the quantities of grapes sold on this market. Table grapes traditionally require careful hand harvesting and expensive packaging. Consumer demand for green, seedless V. vinifera grapes which enter the province duty free, and at relatively low prices, have changed the markets for traditional varieties such as Concord, Campbell Early and Sheridan. The choice of grape varieties available to the producers, to compete on this market has not been satisfactory. New varieties now under evaluation appear to have some promise, but without renewed interest by table grape producers, it is doubtful that the large quantities sold in the past through this channel will be reached again.

Okanagan Sunrise

2. CLIMATE

2.1 MECHANISMS AFFECTING THE MACROCLIMATE OF THE OKANAGAN AND SIMILKAMEEN VALLEYS

The climate in the Okanagan and Similkameen Valleys is governed by the region's location in the lee of the Coast Mountain Range. These mountains, with peaks to over 2450 metres (8 000 ft), are extremely effective at removing moisture from the precipitation bearing westerly winds through orographic lifting of the air mass, resulting in a wet mild climate west of the Coast Range. In the lee of the Coast Mountains, a rain shadow effect is produced and cloud and precipitation amounts are decreased, sunshine is increased, humidities are lowered and the range of seasonal temperature is greater than on the windward side.

During the winter months the predominantly westerly upper air flow (Figure 1) contains weak weather systems which produce light rain or snow in the interior valleys. Occasionally, severe outbreaks of arctic air penetrate into the Okanagan and Similkameen Valleys reducing minimum temperatures below -25°C. Heavy snowfall often occurs as these cold air masses are replaced by more moist and mild Pacific air masses.

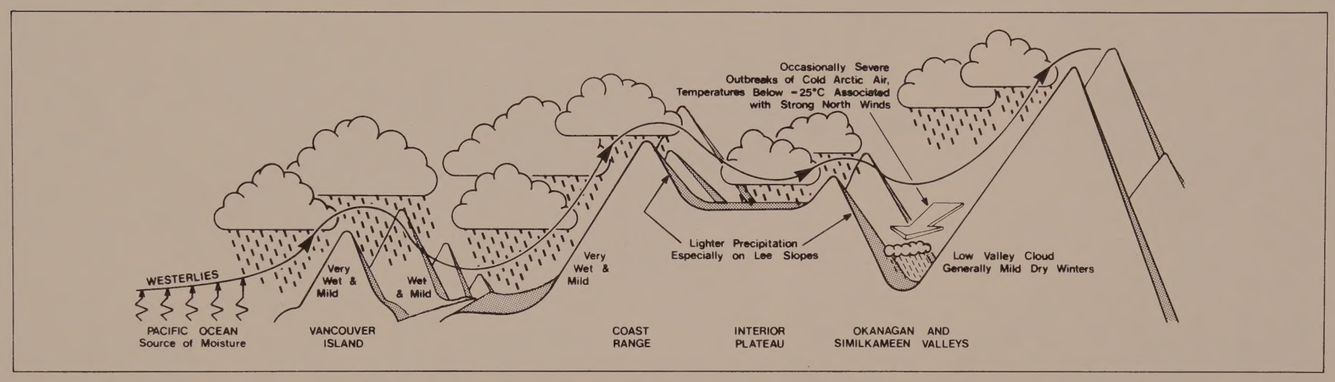

Occasionally Severe Outbreaks of Cold Arctic Air, Temperatures Below -25°C Associated with Strong North Winds
WESTERLIES
Very Wet & Mild
Wet & Mild
Very Wet & Mild
Lighter Precipitation Especially on Lee Slopes
Low Valley Cloud Generally Mild Dry Winters
PACIFIC OCEAN Source of Moisture
VANCOUVER ISLAND
COAST RANGE
INTERIOR PLATEAU
OKANAGAN AND SIMILKAMEEN VALLEYS

Figure 1 Typical Winter Weather Patterns in Southern British Columbia

Summer months in the study area are dry and warm with precipitation usually in the form of brief showers or thunderstorms (Figure 2). June is the wettest month while July, August and September are usually dominated by a high pressure ridge which produces warm and dry conditions over the interior. Brief, very hot periods occur when modified dry continental tropical air invades the area from the desert region of the southwestern United States (Kendrew and Kerr, 1955) often raising temperatures to 35°C or more.

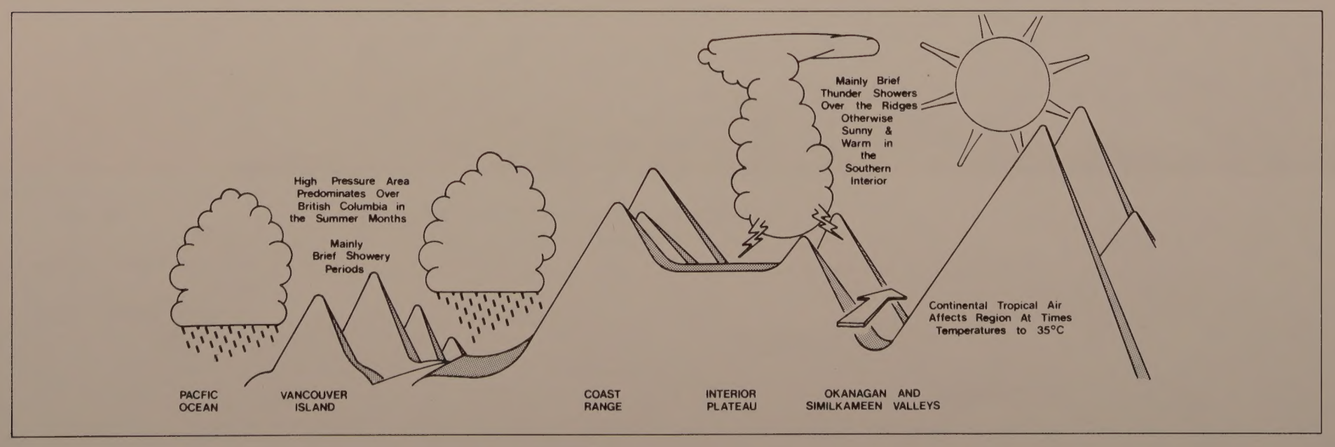

Mainly Brief Thunder Showers Over the Ridges Otherwise Sunny & Warm in the Southern Interior
High Pressure Area Predominates Over British Columbia in the Summer Months
Mainly Brief Showery Periods
Continental Tropical Air Affects Region At Times Temperatures to 35°C
PACFIC OCEAN
VANCOUVER ISLAND
COAST RANGE
INTERIOR PLATEAU
OKANAGAN AND SIMILKAMEEN VALLEYS

Figure 2 Typical Summer Weather Patterns in Southern British Columbia

Climatological data for selected stations in the Okanagan and Similkameen Valleys are included in Appendix A.

Summer Skies

2.2 SOLAR RADIATION

The growing of grapes requires careful consideration of the microclimate of the selected location. Growing conditions are determined largely by the solar radiation received at a site. The sun is the primary energy source for practically all physical and biological processes on earth. Solar radiation has a direct effect on air and soil temperature, transpiration, soil moisture, atmospheric humidity, photosynthesis, and photostimulus processes such as heliotropism, elongation, flowering, etc.

Solar radiation intensity influences the level of soluble solids in grapes. When inadequate solar radiation conditions occur, due to cloudy weather, desirable sugar values may not be reached. Growers can compensate for low solar radiation intensity to some degree by thinning to give a higher ratio of leaves to fruit, and through the use of trellis designs which allow maximum light penetration into the vines.

The amount of solar radiation received at a site varies widely with slope and aspect, particularly in hilly or mountainous areas. Figure 3 illustrates the large variation of total growing season solar radiation at Summerland with slope and aspect. The total growing season solar radiation is the sum of solar radiation, in megajoules per square metre (MJ/m^2), received over the period from April 1 to October 31 (i.e. 1 MJ/m^2 = 8.81 BTU/ft^2). As can be seen from this figure, the greatest amount of solar radiation over the growing season is received on 20° to 40° south-facing slopes. Steep north-facing slopes receive considerably less radiation, while east and west slopes receive an intermediate amount. In general, westerly facing slopes will be warmer than their easterly facing counterparts. This occurs because energy received in the morning is often used to evaporate dew as opposed to heating the air or soil. Within a particular area, warmer air and soil temperatures will occur on southerly and southwesterly sloping sites.

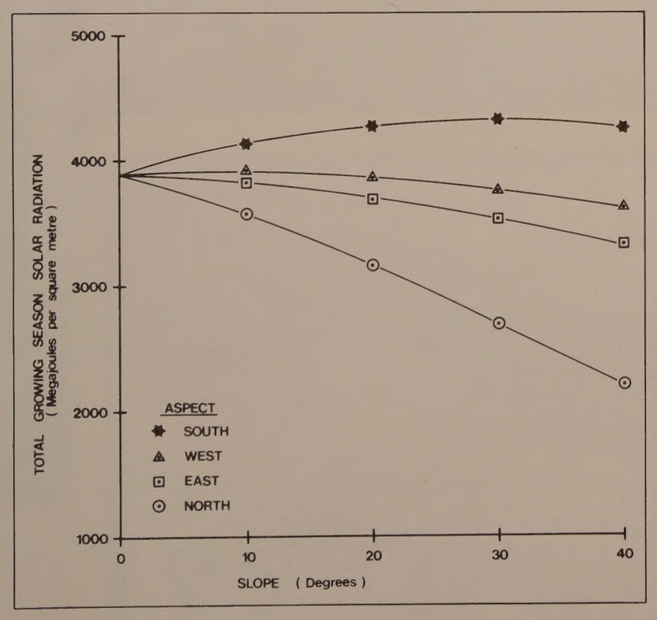


Figure 3 Total Growing Season Solar Radiation (MJ/m^2) at Summerland as a Function of Slope and Aspect

Topographic shading of direct solar radiation from adjacent mountains or hills is a factor to consider when selecting a vineyard site. Sites which are shaded for substantial periods, particularly from the afternoon sun should be avoided.

The solar radiation mapping was produced by applying solar radiation information from Hay (1979) to slope and aspect units delineated on 1:50 000 scale topographic maps.

Four solar radiation classes were developed as follows:

Class	Solar Radiation (MJ/m^2)	Rating
1	4000 and above	Most suitable
2	3600 to 3999	Good suitability
3	3200 to 3599	Fair suitability
4	Less than 3200	Questionable suitability

The area of the Okanagan Valley north of Okanagan Falls to Peachland was mapped using Summerland solar radiation on slopes data. Data from Mount Kobau were used to map the area south of Okanagan Falls including the Similkameen Valley. The portion of the study area from Westbank north was mapped using estimated data derived from Summerland solar radiation information and sunshine data from Kelowna Airport. Total growing season solar radiation for a horizontal surface at Mount Kobau is 4108 MJ/m^2 compared to 3897 MJ/m^2 at Summerland and an estimated 3551 MJ/m^2 at Kelowna, indicating the general solar radiation gradient in the area due to increasing cloudiness from south to north. This reduction in solar energy may result in less suitable environments for grapes when proceeding from south to north through the study area. For example, a 10°north-facing slope in the Similkameen would be rated as Class 2 while the same slope in the Summerland area would be rated as Class 3. Detailed solar radiation data are presented in Tables 12 to 14.

Table 12
Seasonal (April to October) Solar Radiation on Inclined Surfaces at Mt. Kobau (MJ/m^2)

SLOPE (DEGREES)	ASPECT							
	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
10	3774	3827	4029	4241	4349	4309	4125	3898
20	3352	3477	3902	4304	4493	4429	4080	3617
30	2862	3087	3742	4292	4533	4463	3984	3274
40	2354	2701	3556	4196	4475	4406	3844	2924
50	1848	2357	3342	4032	4310	4266	3660	2598
60	1420	2066	3102	3780	4042	4030	3436	2308
Horizontal Surface = 4108								

Table 13
Seasonal (April to October) Solar Radiation on Inclined Surfaces at Summerland (MJ/m^2)

SLOPE (DEGREES)	ASPECT							
	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
10	3570	3624	3818	4025	4132	4089	3907	3689
20	3162	3282	3687	4082	4273	4202	3856	3406
30	2689	2900	3520	4064	4314	4233	3755	3074
40	2200	2520	3328	3965	4259	4174	3609	2729
50	1716	2183	3109	3799	4103	4037	3421	2406
60	1308	1899	2868	3549	3848	3806	3192	2117
Horizontal Surface = 3897								

Table 14
Seasonal (April to October) Solar Radiation on Inclined Surfaces at Kelowna (MJ/m^2)

SLOPE (DEGREES)	ASPECT							
	N	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
10	3254	3302	3479	3668	3766	3726	3560	3362
20	2881	2991	3360	3719	3894	3829	3514	3104
30	2450	2643	3208	3703	3931	3857	3422	2800
40	2004	2296	3032	3613	3881	3803	3289	2486
50	1563	1989	2832	3462	3739	3678	3117	2192
60	1192	1730	2613	3234	3507	3469	2908	1929
Horizontal Surface = 3551								

In the Similkameen and the south Okanagan most agricultural lands fall into Class 1. Only steep northerly facing slopes (>25° slope) fall into Class 4. North of Okanagan Falls the majority of agricultural lands fall into Class 2 with only southerly facing slopes falling into Class 1. Steep northerly facing slopes fall into Class 4 while moderate northerly facing slopes fall into Class 3. Generally, slope and aspect configuration becomes more critical to the microclimatic suitability for grapes in the north and central Okanagan than in the south Okanagan and Similkameen.

Class	Solar Radiation (MJ/m²)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

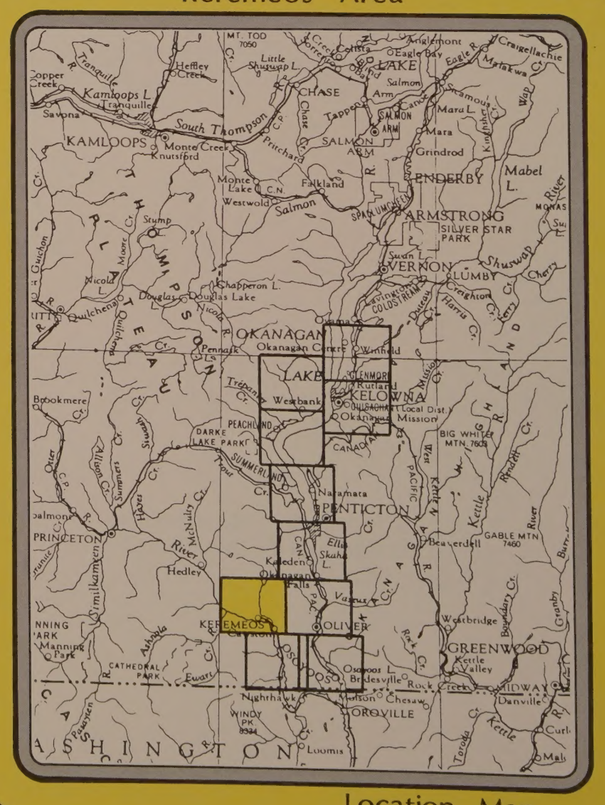
Scale 1:50 000

Metres 1000 0 1000 2000 3000 4000 5000 6000 Metres

Miles 1 0 1 2 3 4 Miles

SOLAR RADIATION

Keremeos Area



Location Map

49°20'00"

120°00'00"

KEREMEOS FORKS
INDIAN RESERVE 12

Keremeos Forks
Indian Reserve 12

Twin Lakes

Creek

Ashnola

Shoemaker

Skaist

Hayes

Similkameen

Keremeos

Columbia

Creek

Abandoned

Village Limits

Trailer Pk

Poultry Farm

Fairgrounds

Gas Pipeline

Transformer Station

Lower Slough

Water

KEREMEOS COLUMNS
PROVINCIAL PARK

ASHNOLA
INDIAN RESERVE 10

ASHNOLA IR 10A

ALEXIS
IR 9

BLIND
CREEK
IR 6

Cawston

Tp 52

Tp 52

BN
RIVER

119°43'00"

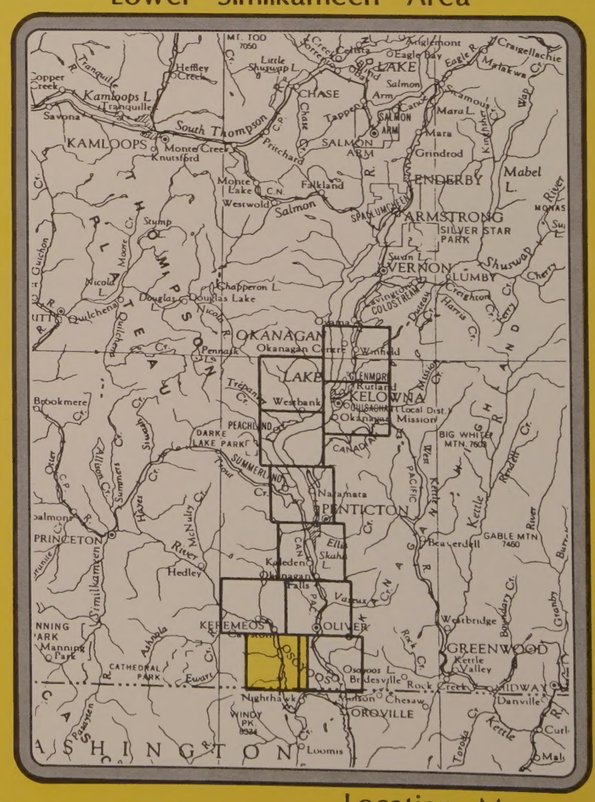
49°10'00"

Class	Solar Radiation (MJ/m²)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000

SOLAR RADIATION

Lower Similkameen Area



Location Map

49°10'00"

119°52'00"

ASHNOLA

INDIAN RESERVE 13

PROVINCIAL

FOREST

NARCISSE'S FARM

IR 4

IR 2

LOWER SIMILKAMEEN

Similkameen

BURLINGTON NORTHERN

Mount Kobau

Television

Radio 200

Observatory

OKANAGAN

PROVINCIAL

FOREST

Golf Course

Tinhorn Creek

Hester Creek

Testalinden Creek

Hunter Creek

Susap Creek

Rabbit Creek

Coulthard Creek

Sproule Creek

Snehumption Creek

Snehumption

Manery Cr.

Water

Gate

SIMILKAMEEN RIVER

SKEMEOSKUANKIN INDIAN RESERVE 7

SKEMEOSKUANKIN INDIAN RESERVE

Transformer Station

RICHTER MOUNTAIN

Richter L.

Fraijk L.

OKANAGAN PROVINCIAL FOREST

Chopaka

Chopaka Customs

BRITISH COLUMBIA

CANADA

119°35'00"

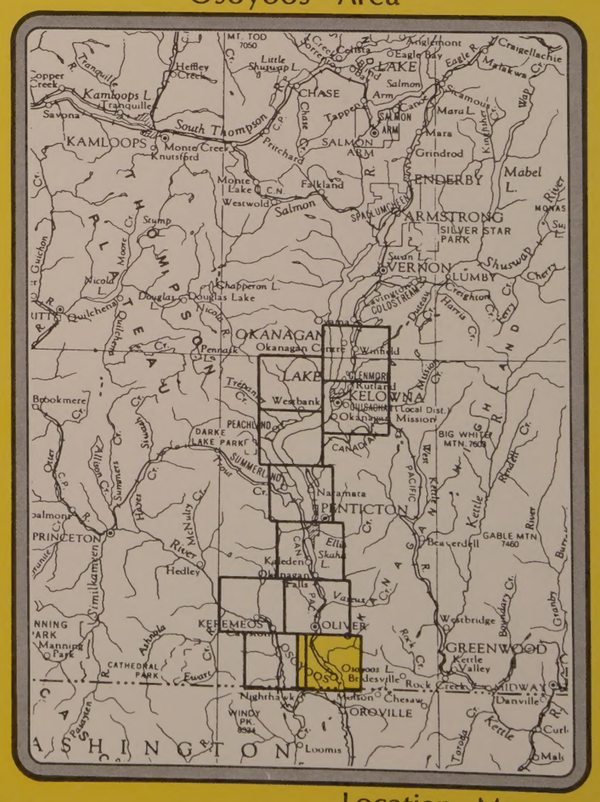
49°00'00"

Class	Solar Radiation (MJ/m^2)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000

SOLAR RADIATION

Osoyoos Area



Location Map

49°10'00"

119°38'00"

INDIAN RESERVE 1

INDIAN RESERVE 1

OKANAGAN

CANADIAN PACIFIC

OSOYOOS LAKE

HAYNES POINT PROV PARK

OKANAGAN MT KRUGER PROVINCIAL FOREST

OKANAGAN PROVINCIAL FOREST

OKANAGAN FOREST

Osoyoos

Golf Course

Nursery

Junk Yard

Pump House

Sluice Gate

Pumping Sta

Haynes

Water

Tinhorn Creek

Hester Creek

Testalinden

Inkaneep

Inkaneep Creek

McCuddy Creek

Haynes Creek

Stanleigh Creek

Stuart Creek

Richter Pass

Lake Drive

Gas Pipeline

Lacey Point

Marina

Museum

Community Center

Theatre

Auto Wrecker

Motel

Golf Course

Campsite

Pump House

Boat Ramp

Campsites

Orchard

Vineyard

Trailer Park

Historic Site

Ecological Reserve 33

Lookout

Anarchist Lookout

Gate

Customs

Transformer Sta

Radio

Tp 51

Tp 49

L 2450s

L 2709

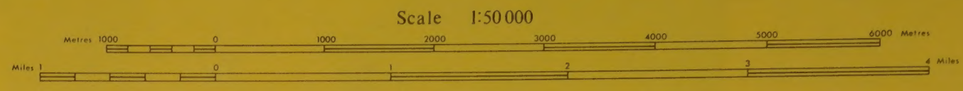
CANADA

49°00'00"

119°21'00"

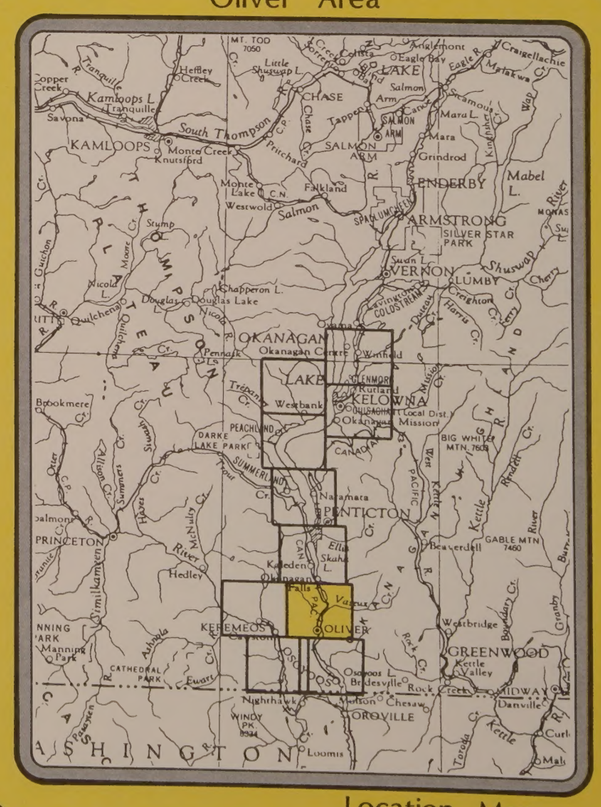
Class	Solar Radiation (MJ /m²)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000



SOLAR RADIATION

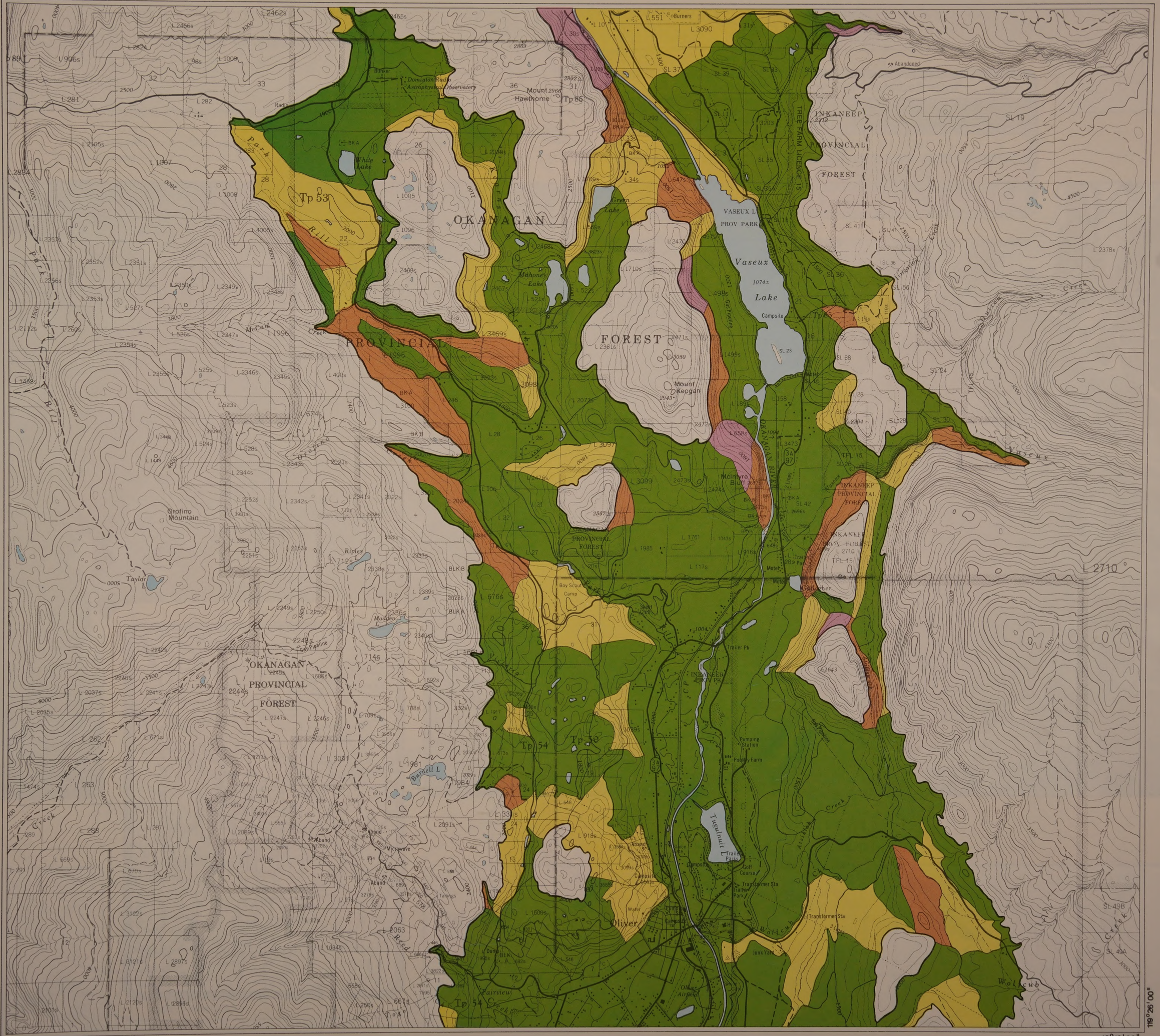
Oliver Area



Location Map

49°20'00"

119°43'00"

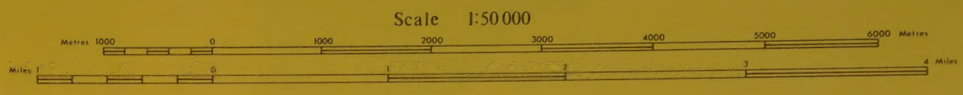


49°10'00"

119°26'00"

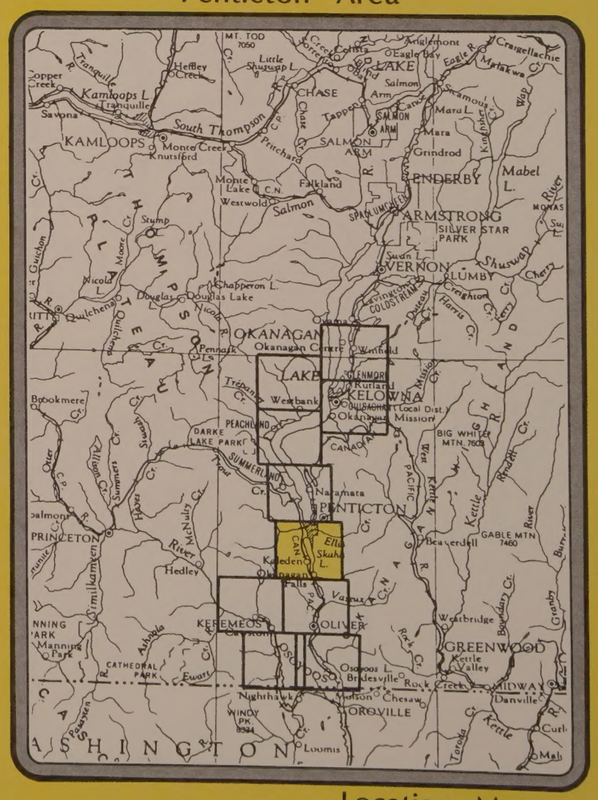
Class	Solar Radiation (MJ/m²)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000



SOLAR RADIATION

Penticton Area



Location Map

49°30'00"

119°45'00"

OKANAGAN PROVINCIAL FOREST

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PENTICTON

PENTICTON

INDIAN RESERVE 1

OKANAGAN

PROVINCIAL FOREST

SKAHA LAKE

OKANAGAN PROVINCIAL FOREST

Kaleden

Okanagan Falls

OKANAGAN FALLS PROVINCIAL PARK

Mount McLellan

Marron Valley

Aeneas Lake

Marron River

Shingle Creek

Skaha Creek

Penticton Airport

Fairleigh Lake

Killey Lake

Trout Lake

Derenzy Lake

Shuttleworth Creek

Stewart Creek

Matheson Creek

Thomas Creek

Hackin Creek

Gas Pipeline

Golf Course

Rifle Range

Sewage

Sawmill

Hospital

Cement Plant

Trailer Park

Campsite

Amusement Park

Marina

Christie Memorial Park

Strip Mine

Lookout

Zoo

Gate

Pumphouse

Water

Trans Stn

Bump

Creek

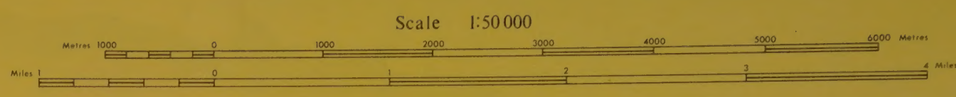
River

119°28'00"

49°20'00"

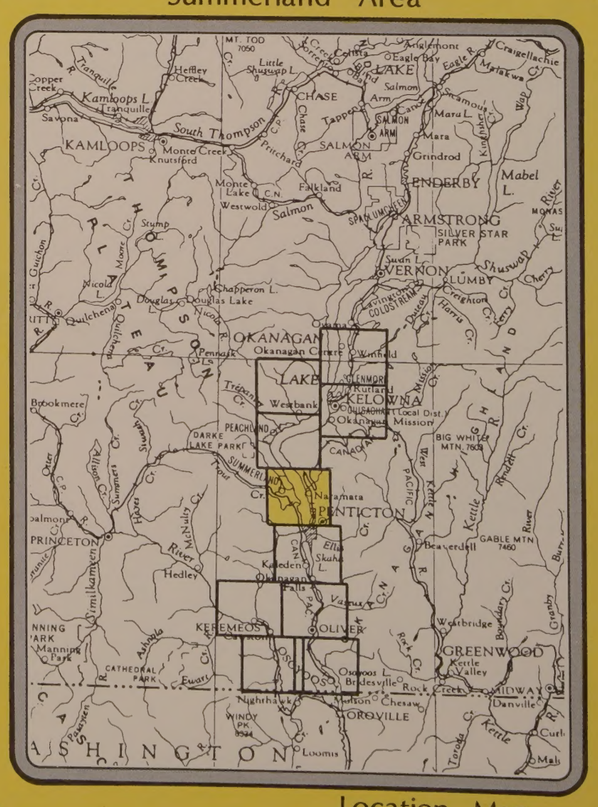
Class	Solar Radiation (MJ /m²)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000



SOLAR RADIATION

Summerland Area



Location Map

49°40'00"

119°47'00"

OKANAGAN LAKE

1123±

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT
OSOYOOS DIVISION OF YALE LAND DISTRICT

OKANAGAN PROVINCIAL FOREST

PENTICTON INDIAN RESERVE 3 A

INDIAN RESERVE 1

OKANAGAN PROVINCIAL FOREST

KICKININEE PROVINCIAL PARK

MUNSON MOUNTAIN PROV. PARK

Summerland

Naramata

Penticton

East Penticton

Okanagan Lake

Naramata Lake

Adra

Faulder

Mount Kobau

Mount Campbell

Mount Conkle

Blue Mountain

Trout Creek

Turnbull Creek

Poplar Grove

Wrosloh

Gartrell Point

Sun-Oka Beach Provincial Park

Manitou Provincial Park

Arawana

Glenfir

Marina

Trailer Park

Golf Course

Arena

Motel

Pumphouse

Breakwater

Radio

Television

Dump

Gate

Park

Flume

Creek

Lookout

Abandoned

Research Station

Experimental Farm

Recreational Reserve

Junk Yard

Water

Pipeline

Trans Mtn Pipeline

Canadian Pacific

Kettle Valley Railway

Kettle River Railway

Kettle Valley Railway

Kettle River Railway

Kettle Valley Railway

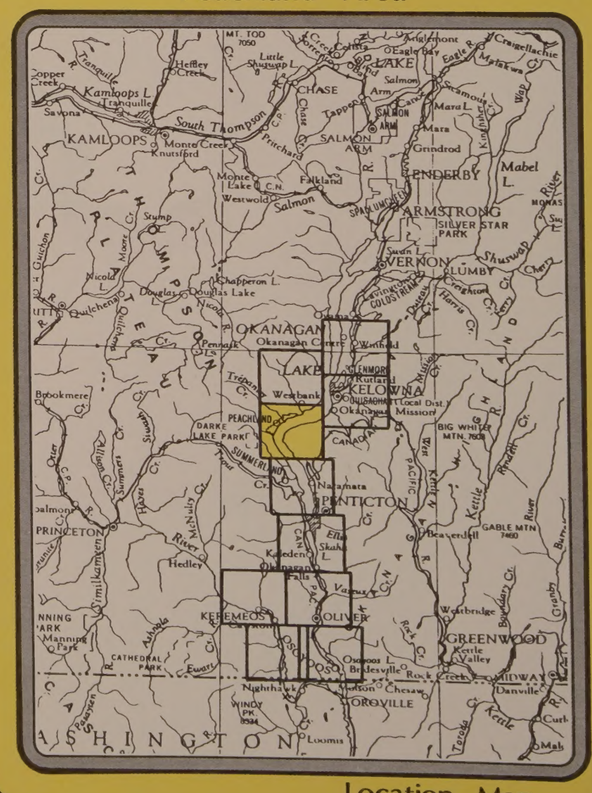
Kettle River Railway

Class	Solar Radiation (MJ/m²)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000

SOLAR RADIATION

Peachland Area



Location Map

49°50'00"

119°49'00"

Mount Law

Mount Drought

Mount Coldham

McCall Lakes

Spring L.

PINCUSHION MTN

Trepanier

Gellatly

Westbank

Camp

Marina

Peachland

Trailer Park

Antlers Beach Provincial Park

Lookout

Rattlesnake Island

Squally Point

Greata

Mount Eneas

Commando Bay

Norman L.

Baker Lake

Okanagan Mountain

Okanagan Mountain Provincial Park

Chute Lake

Gemmill Lake

Dry Creek

Trapper Creek

Pigeon Creek

Peachland Creek

Trepanier Creek

Gulnard Lake

Fredrick Creek

Chute Creek

Gellatly Bay

Wild Horse Canyon

Flume

Pipeline

Gas Pipeline

Trans Sta

Pump

Ck

Reservoir

Tree Nursery

Sawmill

Boulity Farm

Trailer Park

Pk

Mun Yard

Camp

OKANAGAN LAKE

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PEACHLAND DISTRICT MUN

PEACHLAND DISTRICT

OKANAGAN MOUNTAIN PROVINCIAL PARK

VALLEY

TP 28

L 2711

1123±

1643

1676

1663

1279

1344

1320

1300

1130

1131

1184

1185

1186

1187

1188

1189

1190

1191

1192

1193

1194

1195

1196

1197

1198

1199

1200

1201

1202

1203

1204

1205

1206

1207

1208

1209

1210

1211

1212

1213

1214

1215

1216

1217

1218

1219

1220

1221

1222

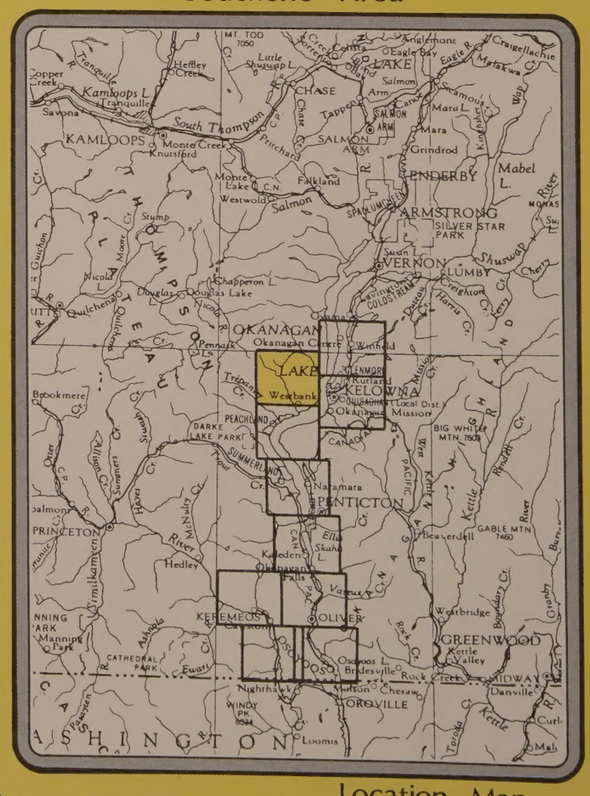
1223

Class	Solar Radiation (MJ/m^2)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000

SOLAR RADIATION

Boucherie Area



Location Map

50°00'00"

119°49'00"

WEST OKANAGAN PROVINCIAL FOREST

PROVINCIAL FOREST

INDIAN RESERVE 9

TSINSTIKEPTUM

TREE FARM LICENCE 9

Dobbin L.
Islaht Lake
Bit Creek
Lily L.
Paynter Lake
Lambly Lake
Lambly Creek
Mount Swite
Red Ck
Bull Rock Creek
Snowbell Ck
Steid Ck
Hayman L.
Banana L.
Powers Creek
Jackpine L.
Carrot Mountain
McDougall Creek
Mount LAST
Mount CLEMENTS
Ski Lift
Television
Hill Creek
Mount Miller
Glenrosa
Shannon Lake
Mount Boucherie
Valley Lake
Control Gate & Dam
Trailer Park
Tree Nursery
Junk Yard
Asphalt Plant
Cement Plant
Pumphouse
Trans Sta
Poultry Farm
Underground Reservoir
Gate
Ditch
Flume
Water
PARK

119°32'00"

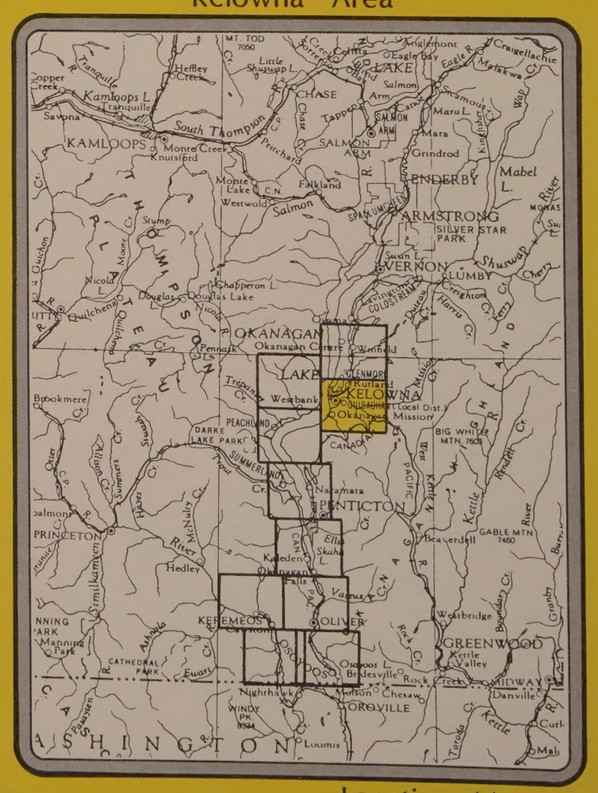
49°50'00"

Class	Solar Radiation (MJ/m^2)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000

SOLAR RADIATION

Kelowna Area



Location Map

49°56'00"

119°32'00"

KELOWNA

Westside

Okanagan Mission

Rutland

East Kelowna

Black Knight Mountain

Mount Knox

Mount Dilworth

Knox Mountain Park

Manhattan Point

Sutherland Hills Prov Park

Mission Beach Prov Park

Okanagan College

Mission Creek

Bulman Creek

Belgo Creek

Bellevue Creek

Fascieux Creek

Kerr Creek

Jack Smith Lake

Fraser Lake

Okanagan Lake

Canadian Pacific Rail

Hydraulic

Flume

Pipeline

Gas Pipeline

City Limits

Golf Course

Trailer Park

Cemetery

Rifle Range

Shopping Centre

Hospital

Reservoir

Pumphouse

Water Pipeline

Transmission Line

Tp 25

Tp 27

Tp 28

Tp 29

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

49°46'00"

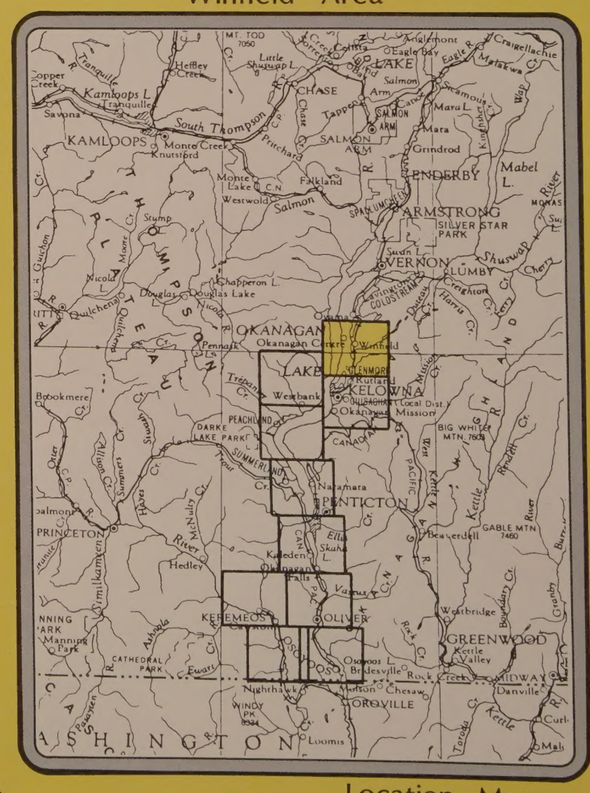
119°15'00"

Class	Solar Radiation (MJ /m²)	Rating
1	4000 and above	most suitable
2	3600 to 3999	good suitability
3	3200 to 3599	fair suitability
4	less than 3200	questionable suitability

Scale 1:50 000

SOLAR RADIATION

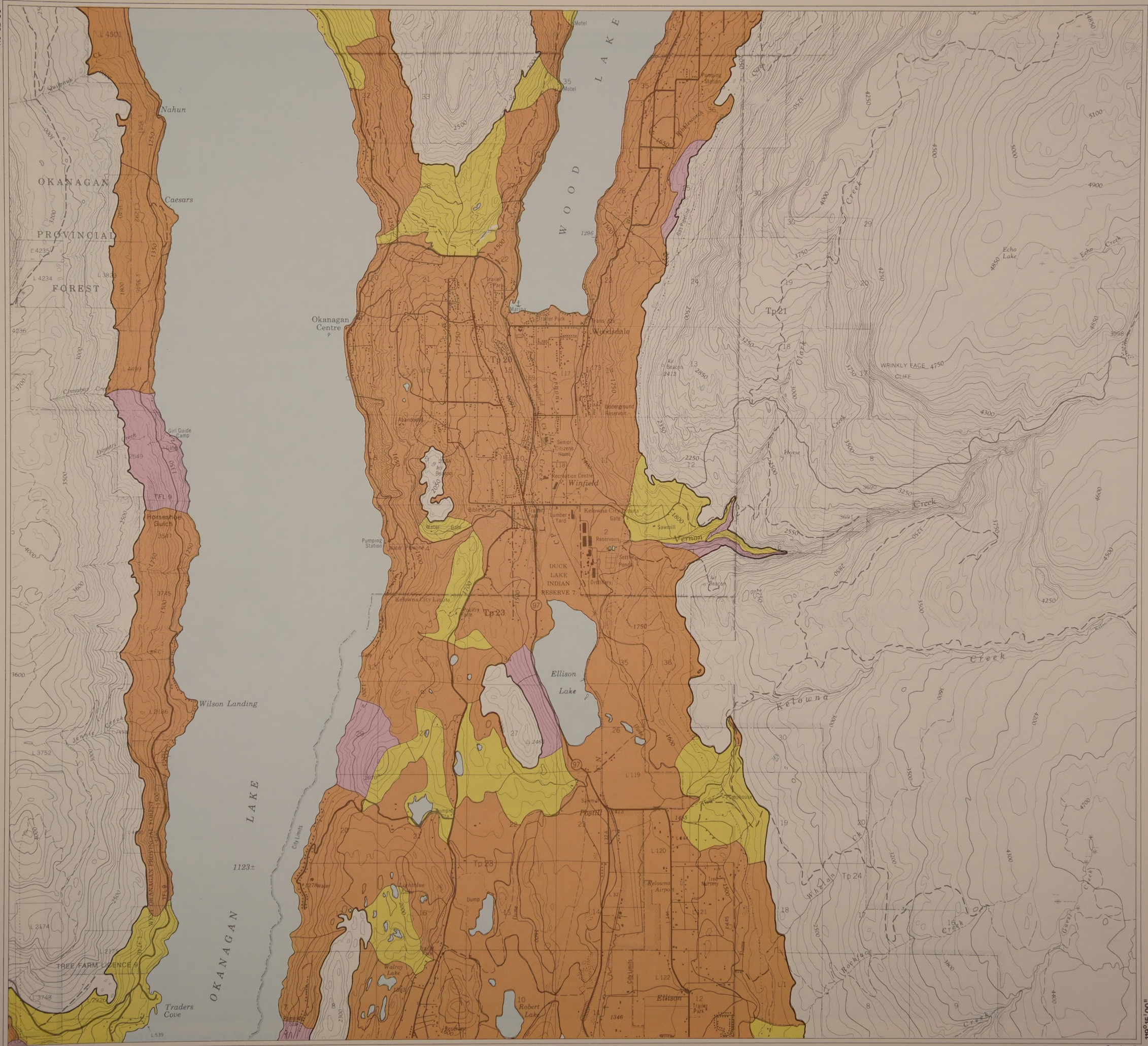
Winfield Area



Location Map

50°06'00"

119°32'00"



49°56'00"

119°15'00"

Experimental Vineyard with Weather Station at Inkameep

The growing degree day or heat unit concept was originally suggested by Reaumur over 200 years ago (Holmes and Robertson, 1959). The degree day theory assumes that plant growth commences at a particular base temperature. It has been determined, for grapes, that growth begins at a mean temperature of 10°C. The accumulation of growing degree days throughout the growing season above the 10°C base temperature permits the assessment of grape growing potential in a region.

The method of calculating growing degree days is quite simple. The growing season, during which degree days are accumulated, must first be specified. The date in spring when degree days begin to be accumulated is defined as the first day of 5 consecutive days with a mean temperature above 10°C. Similarly, the end of the growing season in autumn occurs when there is no longer five consecutive days with a mean temperature above 10°C. The number of degrees (°C) that the mean temperature is above 10° C is accumulated for each day from the first to last day of the growing season. For example, if on a particular day the mean daily temperature is 25°C, the number of growing degree days accumulated to the seasonal total is 15 (e.g. 25-10 = 15).

The growing of most varieties of grapes requires a large accumulation of growing degree days to permit the fruit to ripen. Insufficient degree days will not permit wine grapes to attain the required sugar content. The more heat demanding vinifera and French hybrid grape varieties are most particular in their heat unit requirements. Winkler (1974), in his work with French and German wine grapes in California, found that an accumulation of 1390 degree days was the optimum required. In the German Rhine area, 944 was identified as the lowest accumulated degree day total acceptable for commercial wine grape production. Similarly, Prescott (1965) observed that in Australia heat unit totals should be at least 890 to 1000.

Four growing degree day suitability classes, shown below, were derived based upon the response of vinifera and French hybrid varieties grown in the Okanagan and Similkameen Valleys.

Class	Degree Days	Rating
1	1390 and above	Most suitable
2	1165 to 1389	Good suitability
3	945 to 1164	Fair suitability
4	Less than 945	Questionable suitability

2.3.1 Effect of Growing Degree Days on Grape Quality

The use of the growing degree day concept provides information as to the varieties of grapes that can be grown and the quality of wine that can be produced. Vineyards in Class 4, on average, will experience a short growing season with low temperatures. Very early maturing varieties only, will succeed in this area and acid content may be high unless low acid varieties are grown. Table wines produced from high acid/low sugar grapes will be low in alcohol and dry, as well as tart.

Grapes grown in a Class 1 area will have the longest growing season. Table wines produced from these grapes will have a higher alcohol content and will be somewhat sweeter and more mellow than wine from grapes grown in less suitable areas. The same variety, when grown in the Class 2 region, will generally have a higher acid content than if it had been grown in the Class 1 area. In many cases, the grapes grown in the cooler Class 2 regions will develop more flavour than similar varieties grown in a Class 1 region.

The degree day concept is not without some problems. There is no accounting for a lessening in a plant's growth response at temperatures above about 27°C. Also, no allowance is made for a change in the temperature threshold or the effect of the range between maximum and minimum temperature as a crop develops. Finally, degree day accumulations do not permit the differentiation between the combination of a warm spring and cool summer, and the combination of a cool spring and a warm summer (Chang, 1963).

Despite these drawbacks, the growing degree day method remains an effective, understandable, and readily comparative concept in guiding the grape growing industry throughout the world.

2.3.2 Growing Degree Days in the Okanagan and Similkameen Valleys

A large number of climate stations throughout the Okanagan and Similkameen Valleys have been used in determining and mapping the growing degree day climate. Average degree day figures were calculated for longer term climate stations directly, while the short-term station, with less than 15 years of data, required that long-term averages be estimated. These estimates were calculated by comparing short-term station data to a nearby long-term base station.

To enable an analysis of the growing degree day climate, the large study area was divided into three smaller but more climatically similar subregions. The first subregion, the Similkameen Valley, was identified because it is geographically separate from the Okanagan Valley. Conversely, the Okanagan Valley has been divided into two subregions on the basis of climatic factors. A significant but gradual change in climate occurs from south to north in this valley. More precipitation, cooler temperatures and lower sunshine amounts are evident the further north one proceeds. The most significant change in the climatic region occurs in the Okanagan Falls area. The growing degree day subregions are as follows:

1. Similkameen Valley;
2. Okanagan Valley north from the U.S. Border to Okanagan Falls; and,
3. Okanagan Valley from Okanagan Falls north to Okanagan Centre.

Linear regressions of growing degree days versus the elevation above valley bottom were developed for each of the three subregions. In the Similkameen valley, no mapping was done beyond 40 meters (130 ft) above the valley floor, because of a lack of climatic data.

In the Okanagan Valley, a general increase in growing degree days occurs to about 100 meters (330 ft) above valley bottom. Below this elevation, the number of growing degree days is affected by the cooler temperatures occuring near valley bottom, a result of cool air pooling. Minimum temperatures increase rapidly above the valley floor to about 100 meters (330 ft). A lowering of both minimum and maximum temperatures above 100 meters (330 ft) results in a gradual reduction of growing degree day accumulations. These processes are shown diagrammatically in Figure 4.

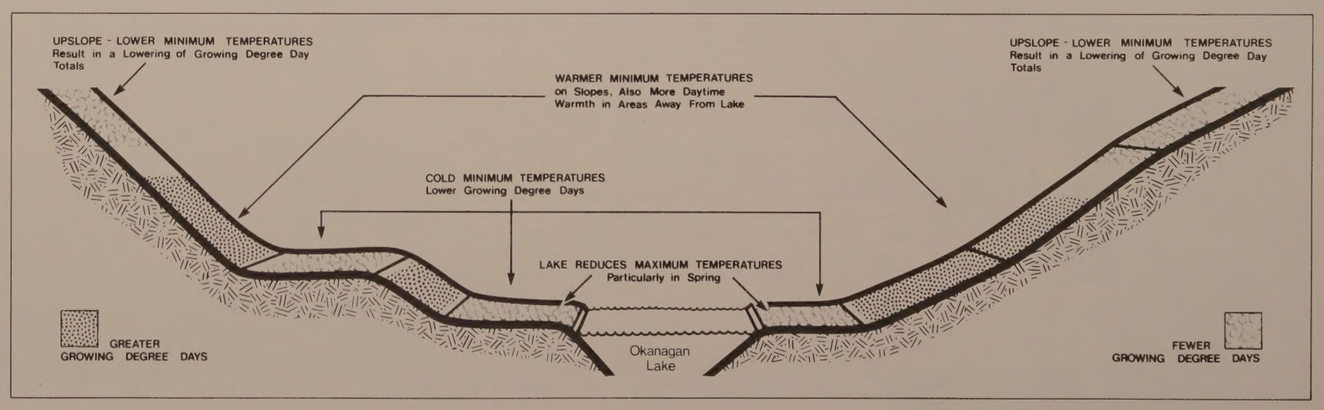

UPSLOPE - LOWER MINIMUM TEMPERATURES
Result in a Lowering of Growing Degree Day Totals
WARMER MINIMUM TEMPERATURES
on Slopes, Also More Daytime Warmth in Areas Away From Lake
UPSLOPE - LOWER MINIMUM TEMPERATURES
Result in a Lowering of Growing Degree Day Totals
COLD MINIMUM TEMPERATURES
Lower Growing Degree Days
LAKE REDUCES MAXIMUM TEMPERATURES
Particularly in Spring
GREATER
GROWING DEGREE DAYS
Okanagan
Lake
FEWER
GROWING DEGREE DAYS

Figure 4 The Effect of Topography and Proximity to Large Lakes on Growing Degree Day Accumulation

2.3.3 Growing Degree Days Patterns

The Similkameen Valley has a warm growing season climate. The number of growing degree days attained is very similar to degree days accumulated throughout the warmest areas of the south Okanagan. This is a result of mild nights and warm days which are experienced throughout the growing season. At night, conditions which normally would be expected to be clear, calm and cool are instead often windy and moderately warm.

Southwesterly slopes experience the highest temperatures resulting in a Class 1 climate with more than 1390 growing degree days. The cooler valley bottoms have a Class 2 growing degree day climate, with the exception of the south end of the subregion where Class 1 is found.

The area from Keremeos west to the Ashnola Valley is cool primarily because of topographic shading and reduced incoming solar radiation. This results in a slight lowering of the growing degree day accumulation to Class 2. Richter Pass, in the vicinity of Frank to Richter lakes, has much cooler maximum and minimum temperatures and, therefore, reaches only a Class 3 growing degree day climate.

Many factors affect heat unit accumulations in the south Okanagan. Away from the moderating affect of the larger lakes valley bottom locations are prone to cold air pooling at night. This cold air pooling lowers heat unit accumulations of the low lying areas resulting in a Class 2 growing degree day climate. Upslope large areas of Class 1 climate extend from just south of Oliver to the U.S. Border on the east side of the valley. There also is some Class 1 on the west side of the valley in the vicinity of Osoyoos Lake and Oliver. Further upslope, the accumulated heat units quickly fall through Class 2 to Class 3. A large area of Class 2 also is located in the Inkameep Creek Valley.

North of Oliver, the Class 2 growing degree day climate extends through most of the valley, except for a narrow band of Class 1 on the east side of the Okanagan River from Tugulnuit Lake to just north of Vaseaux Lake. A substantial block of Class 1 exists on the west side of Skaha Lake near Kaleden and east side south of Gilles Creek to Okanagan Falls. Higher and colder side valley regions, such as Park Rill Creek near Oliver, experience a Class 3 growing degree day climate.

In response to the moderating affects of Okanagan Lake, the central Okanagan growing season climate is slightly cooler than throughout the south Okanagan. During the spring and early summer, the area adjacent to the lake is noticeably cooled by air originating over Okanagan Lake. As a result, the number of degree days accumulated is reduced, and there is an absence of Class 1 growing degree day climate.

Class 2 growing degree day climate exists on the south aspect of Mt. Boucherie and in a very narrow band from Peachland to Mt. Boucherie. A slightly larger area of Class 2 exists from the north end of Skaha Lake to north of Summerland. The east side of Okanagan Lake has a narrow band of Class 2 climate from the north end of Skaha Lake to Squally Point. Above these narrow strips of Class 2, extending north to Westbank on the west side of the lake and north to Squally Point on the east side is an area of Class 3. North of Squally Point to Okanagan Mission, a less favourable northwesterly aspect results in the absence of Class 1 and 2 climates.

There is also a somewhat larger area of Class 2 growing degree day climate on the front benches of East Kelowna in response to the warm night air above the valley bottom. Maximum temperatures are higher

during the day because of favourable east and west aspects, and the increased distance from the cooling influence of Okanagan Lake.

North of Kelowna, in the vicinity of Okanagan Centre, the majority of the area is a Class 3 climate. Large low lying areas south of Winfield are within the Class 4 climate. Kelowna Airport is representative of these low lying sites and is very prone to cold air pooling with a resultant decrease in growing degree days.

2.3.4 The Affects of Microclimate Upon Growing Degree Day Accumulations

It must be stressed that the climate mapping has been based upon data from climate stations in the Okanagan and Similkameen Valleys. Because of microclimatic differences, there are sites that have better or worse climates than the mapping contained herewith indicates. Small heat pockets on south facing slopes, for example, will result in more heat units accumulated. This may improve such localities to a more favoured class. Conversely, poorly exposed low lying areas subjected to cold air drainage, may have lower classifications than those shown on the map.

2.3.5 The Frequency of Occurrences of Growing Degree Day Suitability Classes

It is important to consider the frequency of occurrence of growing degree day suitability classes in addition to the average values mapped. Table 15 provides some of these frequencies for five major climate stations throughout the region.

Keremeos, in the Similkameen Valley, has reached at least a Class 3 growing degree day climate in more than eight out of ten years, a Class 2 rating in more than five out of ten years and a Class 1 in more than two out of ten years. Keremeos has not experienced a growing season with a Class 4 growing degree day climate in twenty-two years of record. The Similkameen Valley in the vicinity of Keremeos has a growing degree day climate similar to that experience in the southern Okanagan Valley.

The Osoyoos station (typical of many lower elevation sites in the south) experiences growing degree day accumulations that reach a Class 3 or better in nine out of ten years. A Class 2 or better climate is experienced in eight out of ten years and a Class 1 rating occurs in more than two out of ten years. The Osoyoos station has never experienced a Class 4 growing degree day suitability rating during the seventeen years of record.

Penticton Airport is a site representative of valley bottom locations in the south central portion of the Okanagan Valley. Here, a Class 3 or better climate occurs in eight out of ten years, a Class 2 or better climate in one out of ten years and a Class 1 rating has occurred only once in thirty-nine years.

Summerland C.D.A., a site typical of warmer upslope locations in the south central Okanagan, has a much more advantageous growing degree day climate for grapes than does Penticton Airport. This is not only expressed in the growing degree day averages, but is also reflected in the frequency analysis. A Class 2 is reached in more than five years out of ten compared to one year in ten at Penticton Airport. Also, the best growing degree day climate rating (Class 1) has occurred four years in sixty-four at Summerland C.D.A.

There currently is an absence of operating long term climate stations in the Kelowna area and as a result, the northern portion of the study area has been represented by Okanagan Centre. This station displays a Class 3 climate or better in eight out of ten years, while a Class 2 may be expected more than two times in ten years. This is better than Penticton Airport's growing degree day climate, but not as good as Summerland's figures. Okanagan Centre, in forty-three years of record, has not observed a Class 1 suitability rating.

Table 15
Frequency of Growing Degree Days Suitability Classes

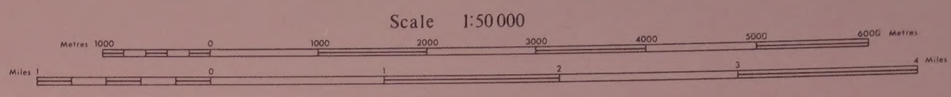
STATION	LATITUDE	LONGTITUDE	ELEVATION in meters (ft)	CLASS				AVERAGE (5 of 10 yrs)		PERIOD OF RECORD
				1	2	3	4	DEGREE DAYS	CLASS	
Keremeos	49° 12'N	119° 47'W	430 (1410)	2 of 10 yrs	5 of 10 yrs	8 of 10 yrs	0 of 22 yrs	1336	2	22 Years
Osoyoos	49° 03'N	119° 31'W	326 (1069)	2 of 10 yrs	8 of 10 yrs	9 of 10 yrs	0 of 17 yrs	1359	2	17 Years
Penticton Airport	49° 28'N	119° 36'W	342 (1122)	1 of 39 yrs	1 of 10 yrs	8 of 10 yrs	9 of 10 yrs	1071	3	39 Years
Summerland C.D.A.	49° 34'N	119° 39'W	455 (1492)	1 of 16 yrs	5 of 10 yrs	9 of 10 yrs	1 of 16 yrs	1172	2	64 Years
Okanagan Centre	50° 04'N	119° 27'W	348 (1141)	0 of 43 yrs	2 of 10 yrs	8 of 10 yrs	9 of 10 yrs	1049	3	43 Years

Example: Osoyoos reaches a Class 3 suitability or better in 9 out of 10 yrs, a Class 2 or better in 8 out of 10 yrs and a Class 1 in more than 2 out of 10 yrs. Class 4 has not occurred during the period of record. The average value (5 out of 10 yrs), Class 2, was used for mapping purposes.

Vine Trimming near Vernon

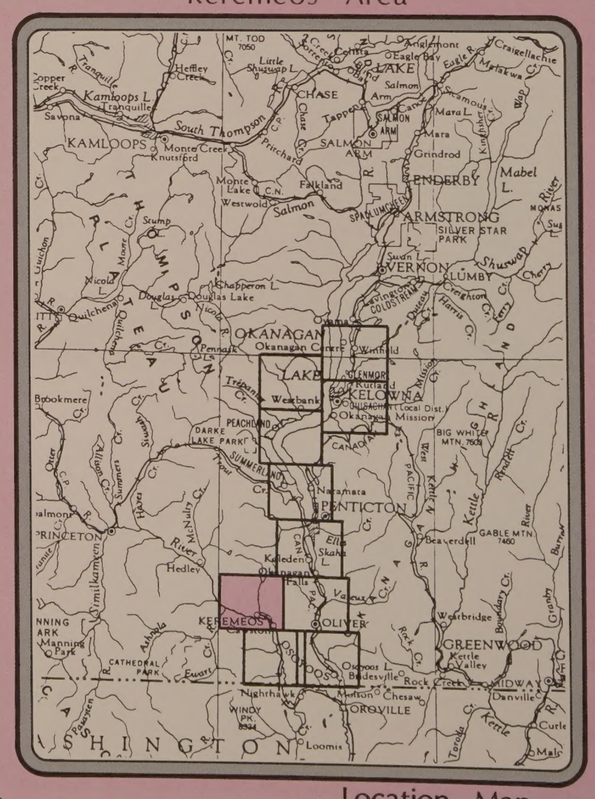
Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000



GROWING DEGREE DAYS

Keremeos Area



Location Map

49°20'00"

120°00'00"

KEREMEOS FORKS INDIAN RESERVE 12

Keremeos Forks Indian Reserve 12

Kwin Lakes

Loak Creek

Ala Creek

Ala Creek

Hurst Creek

Hurst Creek

Keremeos

Keremeos

Keremeos Creek

Keremeos Creek

Broadshaw Creek

Shoemaker Creek

Alalia Creek

Abandoned

Olalla

KEREMEOS COLUMNS PROVINCIAL PARK

Mount Kobau

Mount Kobau

Hurst Creek

Hurst Creek

Manuel Creek

ASHNOLA INDIAN RESERVE 10

ASHNOLA IR 10 P

ASHNOLA

ALEXIS IR 9

SIMILKAMEEN

Village Limits

Trailer Pk.

Poultry Farm

Keremeos

Fairgrounds

Gas Pipeline

Private

Slough

KEREMEOS RIVER

BN

Creek

Tp 52

Tp 32

BLIND CREEK IR 6

Cawston

Lower Slough

Transformer Station

Water

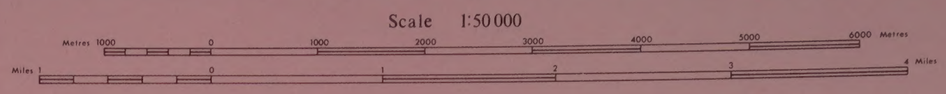
Pk

49°10'00"

119°43'00"

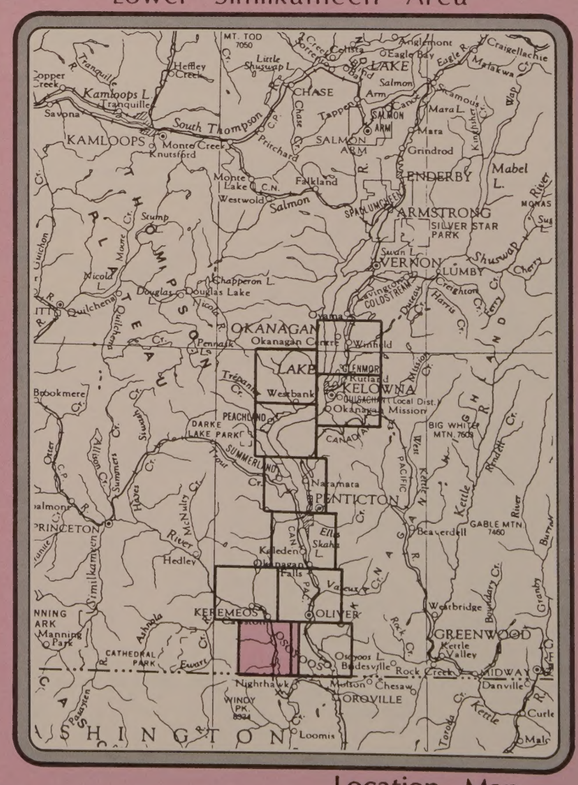
Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000



GROWING DEGREE DAYS

Lower Similkameen Area



Location Map

49°10'00"

119°52'00"

ASHNOLA

INDIAN RESERVE 13

PROVINCIAL

FOREST

NARCISSE'S FARM

LOWER SIMILKAMEEN IR 2

BURLINGTON NORTHERN

OKANAGAN

PROVINCIAL

FOREST

Mount Kobau

Golf Course

Television

Radio-Tel Observatory

SKEMEOSKUANKIN INDIAN RESERVE 8

SIMILKAMEEN RIVER

RICHTER MOUNTAIN

Transformer Station

SKEMEOSKUANKIN INDIAN RESERVE 7

Richter L.

Frank L.

OKANAGAN PROVINCIAL FOREST

Chopaka

CANADA

BRITISH COLUMBIA

Chopaka Customs

49°00'00"

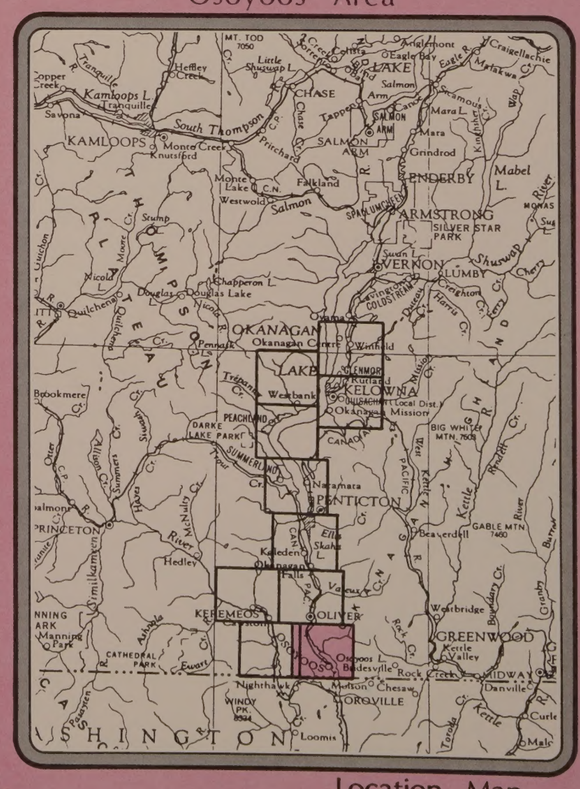
119°35'00"

Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000

GROWING DEGREE DAYS

Osoyoos Area



Location Map

49°10'00"

119°38'00"

INDIAN RESERVE 1

INDIAN RESERVE 1

OKANAGAN

OKANAGAN FOREST

OKANAGAN PROVINCIAL FOREST

OKANAGAN MT KRUGER PROVINCIAL FOREST

OSOYOOS LAKE

HAYNES POINT PROV PARK

DEADMAN LAKE PARK

Haynes Creek

Tinhorn Creek

Hester Creek

Testalinden Creek

Inkaneep Creek

Inkaneep

Deadman Creek

Kilpoola Lake

Richter L

Blue L

Osoyoos

Lacey Point

Golf Course

Nursery

Pump House

Sluice Gate

Pumping Sta

Transformer Sta

Trailer Park

Campsite

Historic Site

Ecological Reserve 33

Lookout

Marina

Museum

Community Center

Theatre

Auto Wrecker

Motel

Orchard

Vineyard

Sewage

Boat Ramp

Anarchist Lookout

Customs

Gas Pipeline

Ditch

Tp 51

Tp 49

L 2450s

L 2709

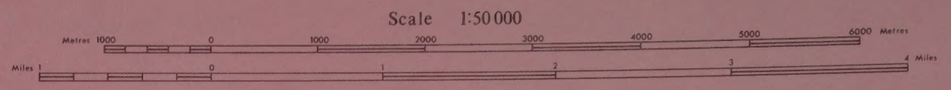
CANADA

49°00'00"

119°21'00"

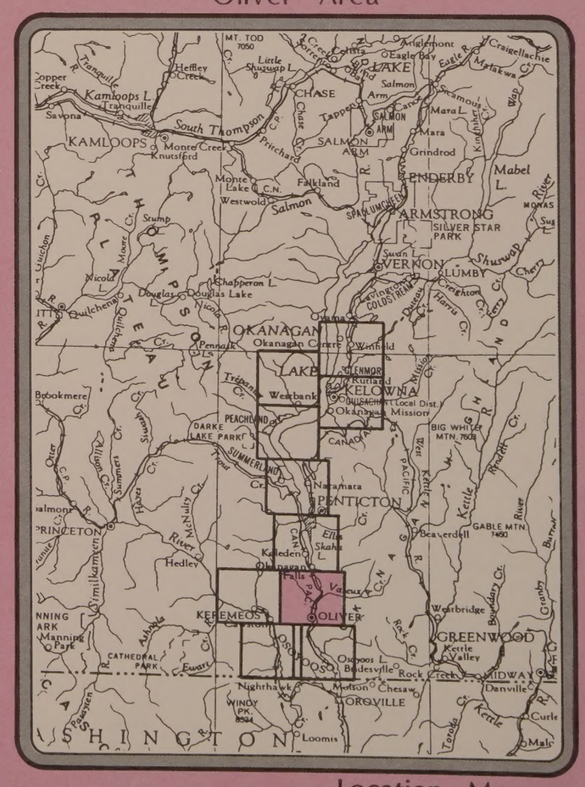
Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000



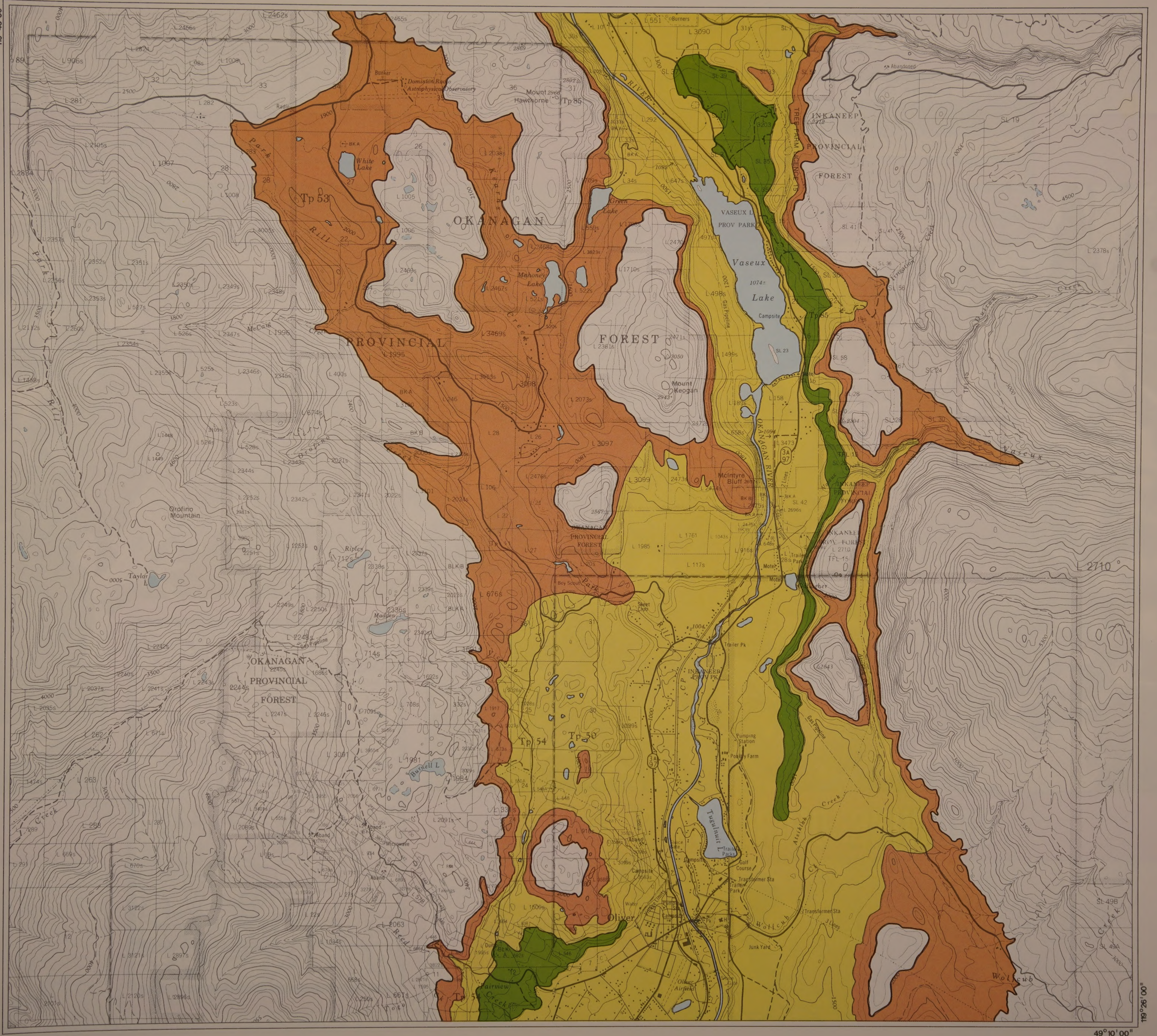
GROWING DEGREE DAYS

Oliver Area



49°20'00"

119°43'00"

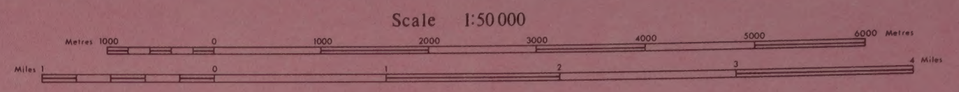


49°10'00"

119°26'00"

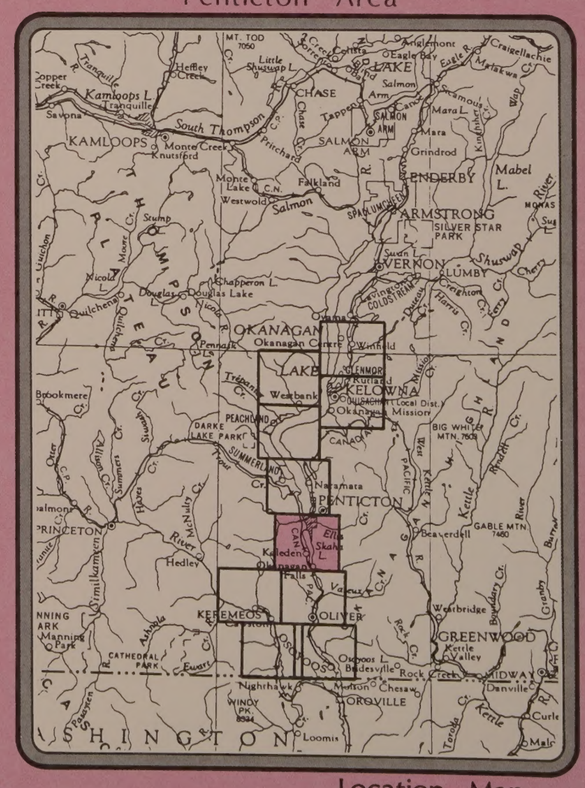
Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000



GROWING DEGREE DAYS

Penticton Area



Location Map

49°30'00"

119°45'00"

OKANAGAN PROVINCIAL FOREST

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PENTICTON

INDIAN RESERVE 1

OKANAGAN

L 2710

PROVINCIAL

FOREST

SKAHA

LAKE

Shingle Creek

Skaha Creek

Penticton Airport

Skaha Park

Campsite

Lookout

Gas Pipeline

Stewart Creek

Ellis Creek

Trailer Park

Golf Course

Radio Tower

Hospital

Sewage

Pumphouse

Sawmill

Water

Gate

Trans Site

Weigh Scale

Marron River

Marron Valley

Aeneas Lake

Fairleigh Lake

Trait Lake

Kitley Lake

Mount McLellan

OKANAGAN FALLS PROVINCIAL PARK

Okanagan Falls

Christie Memorial Park

Derenzy Lake

Shuttleworth Creek

Mathieson Creek

McTavish Creek

Harkin Creek

Thomas Creek

Derenzy Creek

Golf Course

Strip Mine

Bump

Lagoon

Marina

Amusement Park

Rifle Range

Butts

Civic Centre

Museum

Burns Sawmill

Concrete Plant

Gas Pipeline

Tp 58

1125

1108±

1478±

119°28'00"

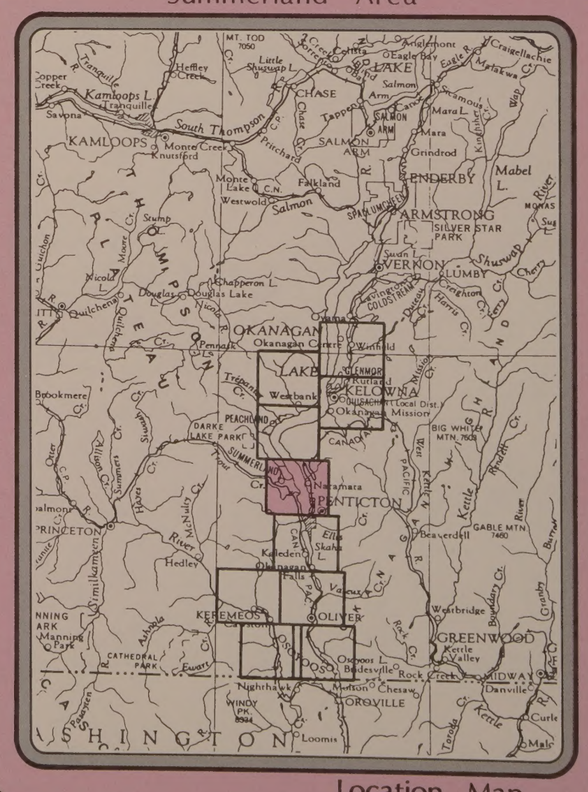
49°20'00"

Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000

GROWING DEGREE DAYS

Summerland Area



Location Map

49°40' 00"

119°47' 00"

OKANAGAN LAKE

1123±

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT
OSOYOOS DIVISION OF YALE LAND DISTRICT

OKANAGAN PROVINCIAL FOREST

Summerland

Naramata

Adra

Faulder

Glenfir

Naramata Lake

Manitou Provincial Park

Arawana

Trout Creek

Penticton Creek

Ellis Creek

Shingle Creek

Garnet Valley

Turnbull

Poplar Grove

Mount Nkwala

Mount Campbell

MOUNT CONKLE

BLUE MOUNTAIN

PENTICTON INDIAN RESERVE 3 A

PENTICTON INDIAN RESERVE 1

KICKININEE PROVINCIAL PARK

MUNSON MOUNTAIN PROV PARK

PENTICTON

East Penticton

Winslow Creek

Okanagan Falls Provincial Park

Shell Oil Beach Provincial Park

Gartrell Point

Trout Creek Point

Research Station

Golf Course

Trailer Park

Marina

Pumphouse

Breakwater

Television 104

Lookout

Dump

Gate

Junk Yard

Cement Plant

Ponds

Arena

Motel

Park

Radio

Abandoned

Water

Gas Pipeline

Canadian Pacific

Kettle Valley Railway

Fish Creek

Brent Lake

Mountain Lake

Mountain Lake

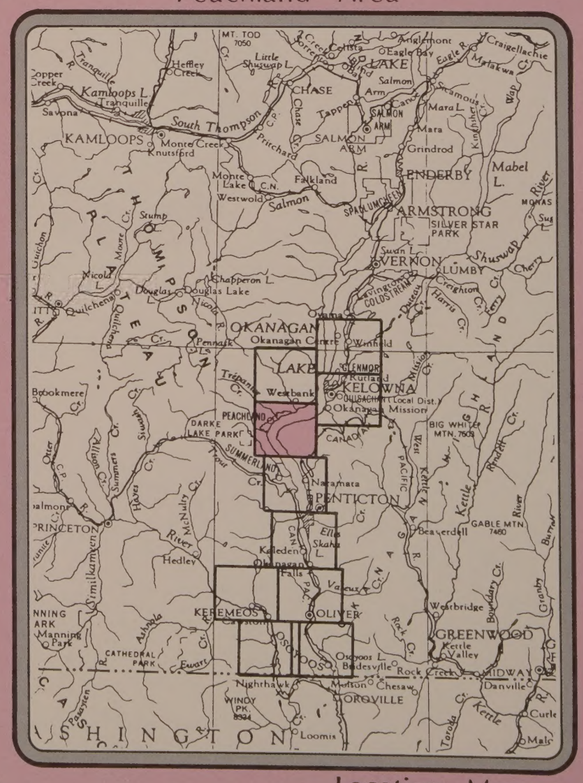
Mountain

Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000

GROWING DEGREE DAYS

Peachland Area



Location Map

49°50'00"

119°49'00"

Mount Law

Mount Drought

Mount Coldham

McCall Lakes

Spring L.

PINCUSHION MTN

Trepanier

Peachland

Westbank

Gellatly

Marina

Camp

Trailer Park

Antlers Beach Provincial Park

Lookout

Rattlesnake Island

Squally Point

Greata

Mount Eneas

Garnet Lake

OKANAGAN LAKE PROVINCIAL PARK

Commando Bay

OKANAGAN MOUNTAIN PROVINCIAL PARK

Okanagan Mountain

Norman L.

Baker Lake

Devils Lake

Gemmill Lake

Chute Lake

OKANAGAN LAKE

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PEACHLAND DISTRICT MUN.

WILD HORSE CANYON

TP 28

L 2711

VALLEY

49°40'00"

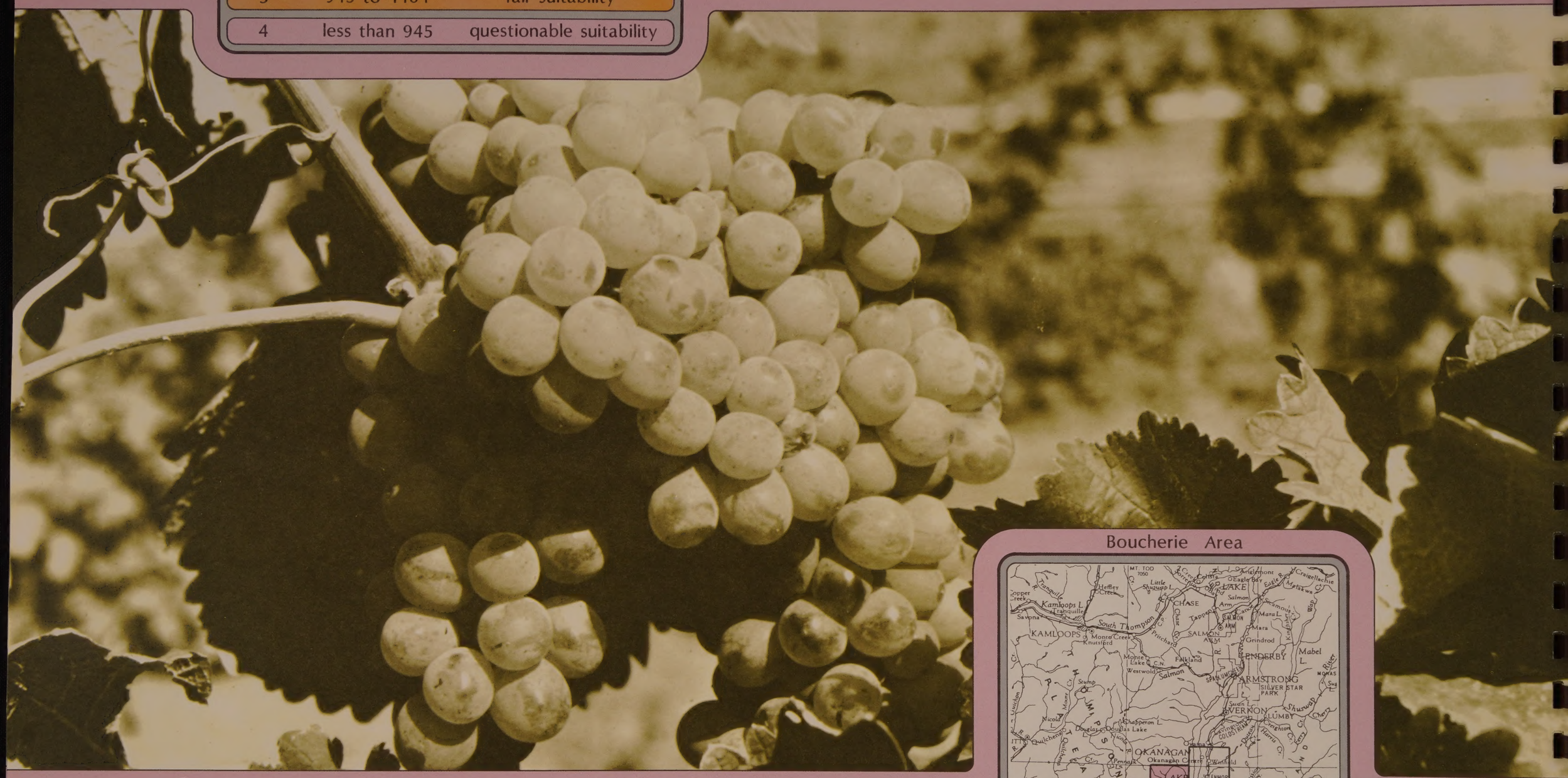
119°32'00"

Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000

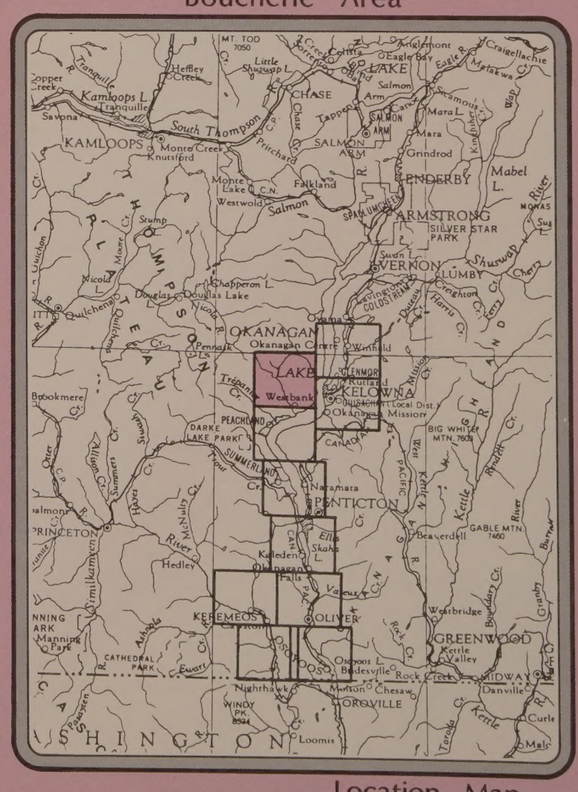
Metres 1000 0 1000 2000 3000 4000 5000 6000 Metres

Miles 0 1 2 3 4 Miles



GROWING DEGREE DAYS

Boucherie Area



Location Map

50°00'00"

119°49'00"

WEST OKANAGAN PROVINCIAL FOREST

PROVINCIAL FOREST

TSINSTIKEPTUM INDIAN RESERVE 9

PARK

Dobbin L.
Inlaht Lake
Bit Creek
Lily L.
Paynter Lake
Lambly Lake
Lambly Ck
TREE FARM LICENCE 9
Mount Swite
Reid Ck
Bessette Creek
Snowbell Ck
Sweid Ck
Lambly Creek
Banana L.
Powell Creek
Jackpine L.
Carrot Mountain
McDougall Creek
Hayman L.
Hayman Creek
Duteau Creek
Valley Lake
Control Gate & Dam
Dutch Meadow Creek
Pumphouse Creek
Mount Boucherie
Shannon Lake
Trailer Park
Tree Nursery
Asphalt Plant
Cement Plant
Junk Yard
Dump
Trans Sta
Poultry Farm
Underground Reservoir
Trailers
Water
Gate
Ditch
Pumphouse
MOUNT LAST
MOUNT CLEMENTS
Mount Miller
Glenrosa
Hill Ck
Ski Lift
Television
Tanner Creek
Lack Creek

49°50'00"

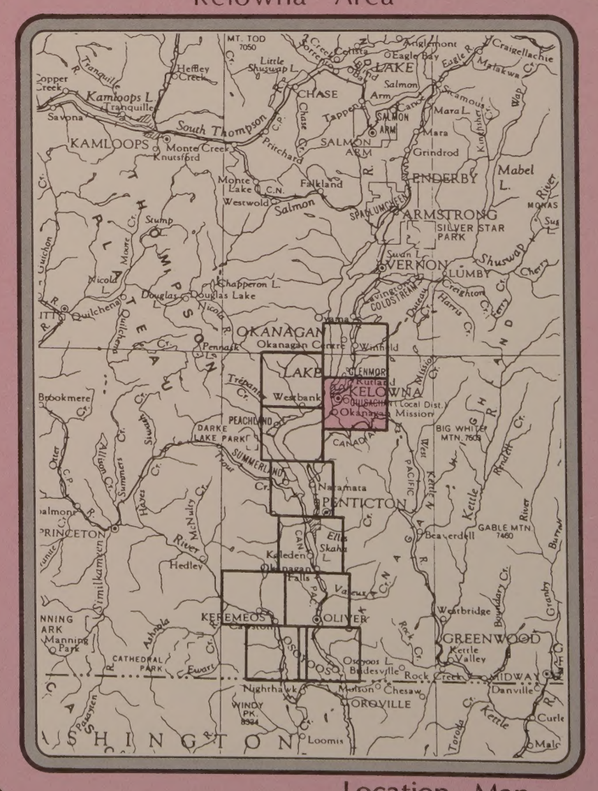
119°32'00"

Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000

GROWING DEGREE DAYS

Kelowna Area



Location Map

49°56'00"

119°32'00"

KELOWNA

Westside

Rutland

Okanagan Mission

East Kelowna

Black Knight Mountain

Mount Knox

Mount Dilworth

Knox Mountain Park

Rutland Community Provincial Park

Sutherland Hills Prov Park

Mission Beach Prov Park

CANADIAN Kelowna Rd

MISSION CREEK

Okanagan Lake

Okanagan

Hydraulic

Jack Smith Lake

Fraser L.

Kerkbler Creek

Mission Creek IRR.

CANADIAN PACIFIC RLWY.

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

Tp 25

Tp 26

Tp 27

Tp 28

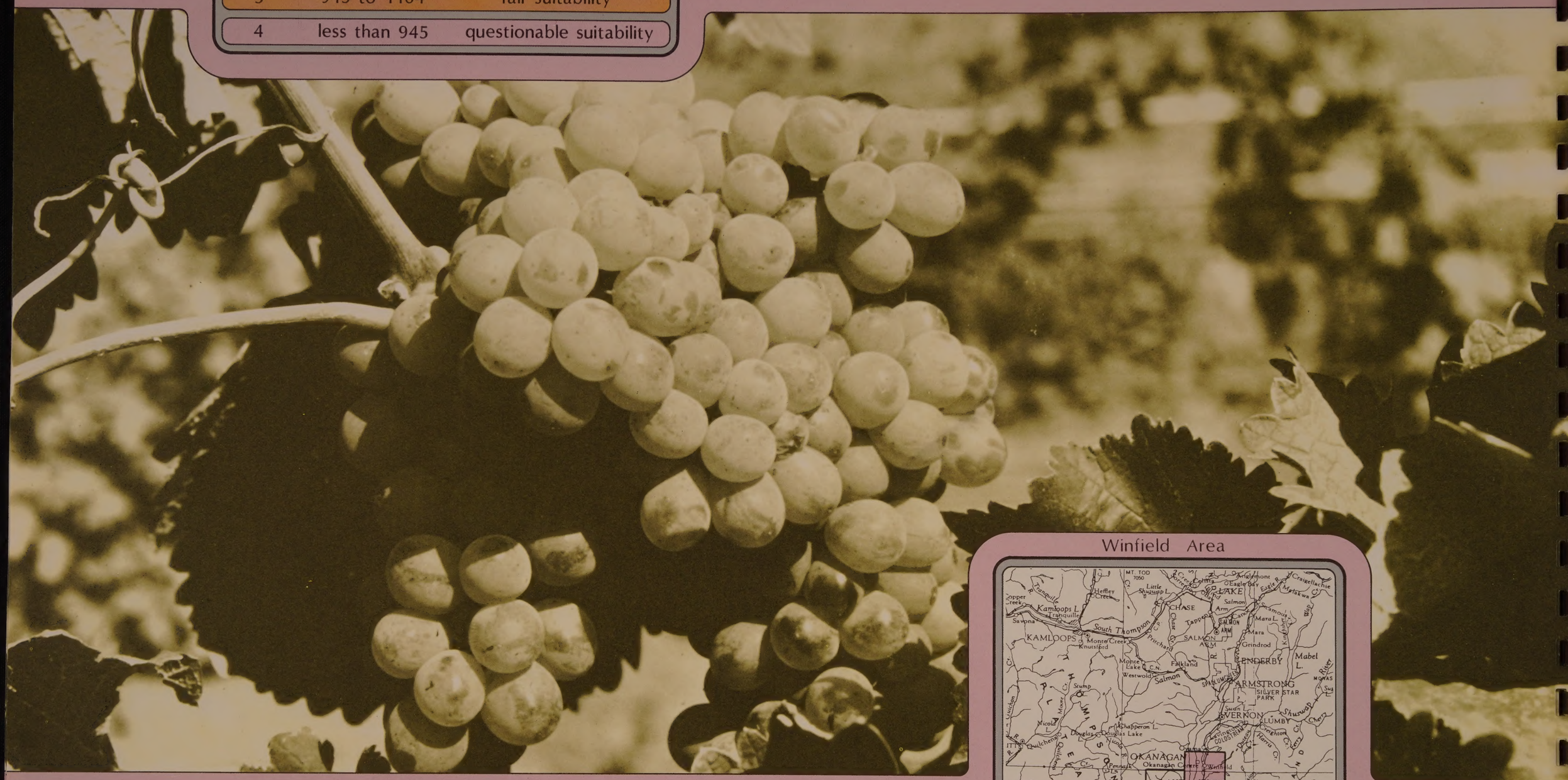
Tp 29

119°15'00"

49°46'00"

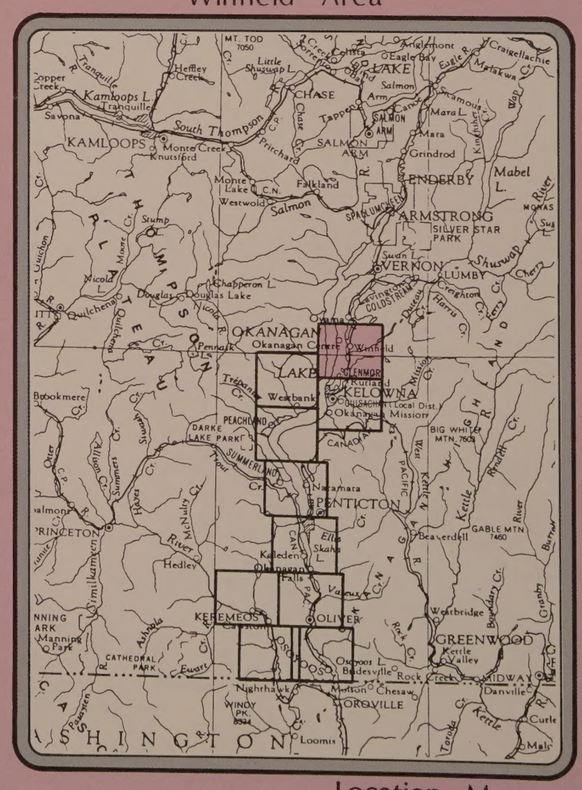
Class	Degree Days	Rating
1	1390 and above	most suitable
2	1165 to 1389	good suitability
3	945 to 1164	fair suitability
4	less than 945	questionable suitability

Scale 1:50 000



GROWING DEGREE DAYS

Winfield Area



50°06'00"

119°32'00"

49°56'00"

119°51'00"

Heavy Autumn Frost Damage to Leaves

2.4 AUTUMN FREEZE RISK

Autumn freezes are a very important factor with respect to grape growing in the Okanagan and Similkameen Valleys. A temperature of -1°C at vine height will kill actively growing grape leaves. Leaf kill prevents further accumulations of sugar within the grapes and delays the maturing of the grapevines making them more susceptible to winter cold.

Paroschy and Meiering (1978) determined that a recuperative period of three to four weeks is required between the time when grapes mature and the first autumn freeze of -1°C. These authors found that over-cropping and late shoot growth delays the accumulation and concentration of protective tissue in the vines.

Several freeze risk research studies have been completed throughout the world in areas where spring and autumn freezes have caused damage to crops. Van Eimern (1968) discussed an extensive freeze risk mapping program in Germany. Bootsma (1976) in an analysis in the hilly terrain of Prince Edward Island used mobile temperature traverses and both short and long term weather stations to determine the clear night temperature regime. This enabled Bootsma to estimate the dates when the 50% (average) and 20% freeze risk occurs in spring and autumn for localities throughout Prince Edward Island. In British Columbia, Davis (1978) completed a spring freeze risk analysis for tree fruits in the Okanagan and Similkameen Valleys and Chilton (1980) assessed spring freeze risk for fruits, vegetables and Douglas-fir seed orchard trees grown on the Saanich Peninsula of Vancouver Island.

Autumn freezes affect the grape crop in the Okanagan and Similkameen Valleys much more than late spring freezes. Denby and Vielvoye (1974) observed that the 1972 grape crop was very badly damaged by early autumn freezes particularly in the Oliver to Osoyoos area. The vines that were most affected by the low temperatures of September 17 to 25, 1972 were in areas where air drainage was poorest. The autumn freezes observed in many of the low lying areas resulted in an early loss of foliage. This prevented vines from reaching full dormancy since the manufacture and translocation of carbohydrates was inhibited. The grapevines were not hardy and severe winter damage occurred as a result of a cold arctic outbreak on December 6 to 8, 1972. The observed winter damage was accentuated by the tendency for some growers to overcrop their vines. Overcropping delays harvest since the greater the crop, the greater the number of degree days required for the crop to ripen.

Early autumn freezes in October of 1981 and 1982 were observed to end the growing season for grapes in many low lying freeze prone localities. As a result, grapes grown in these areas did not attain sufficient sugars to be suitable for wine production. The determination of the probability of autumn freezes is extremely important to the production of grapes in the Okanagan and Similkameen Valleys.

2.4.1 Methodology For Autumn Freeze Risk Analysis

Data for the freeze risk analysis were obtained from a network of weather stations operated by the Federal and Provincial Ministries of Environment and Provincial Ministry of Agriculture and Food. Five base stations were also established specifically to support the Grape Atlas project.

Temperature data were collected on clear calm nights in autumn at various locations throughout the Okanagan and Similkameen Valleys using a rapid response thermometer attached to a vehicle and set to a height of 1.5 meters above ground level. A similar mobile temperature technique has been used very successfully elsewhere to discern the pattern of minimum temperatures to be expected on clear calm nights (Harrison, 1967; Lomas, 1967; Bootsma, 1976; Davis, 1978; Chilton, 1980). Temperatures were recorded at frequent intervals throughout the most critical regions of the study area.

A most valuable aid in delineating the temperature patterns on clear autumn nights was the thermal imagery data collected on the morning of October 25, 1981 by Mars Aerial Remote Sensing Ltd. using a Daedolus DS 1230 scanner mounted in a jet aircraft operated by Canada Centre for Remote Sensing. The patterns on the 1:50 000 scale thermal imagery show the cooler surface temperature areas as lighter tones and the warmer surface temperatures as darker tones.

Considerable information was also obtained by observing the extent of freeze damage to grapevines during the 1981 and 1982 autumns. Phenological observations such as these help to delineate minimum temperature patterns especially in regions where little or no other climate information exists. Finally, although the autumn temperature regime differs somewhat from spring patterns, the spring freeze risk maps for tree fruits helped to delineate warm and cold areas throughout the region.

The spring frost risk, mobile temperature and thermal imagery data were used in mapping the average temperature difference from a permanent weather station that can be expected on clear calm nights. October 10 has been chosen as the most relevant date upon which to assess the freeze risk for grapes throughout the Okanagan and Similkameen Valleys. After this date, only a very few heat units are accumulated making it of little benefit to retain grapes on the vine. Apart from this consideration, grapes must be off the vines well before a severe autumn freeze to permit the vines to recover and prepare for the winter. The grape leaves must remain on the vines for three to four weeks after harvest to permit the accumulation of carbohydrate reserves in the storage tissue. The accumulation of carbohydrates is responsible for the grapevines becoming winter hardy (Paroschy and Meiering, 1978).

The large area encompassed by the Grape Atlas necessitated that the Autumn Freeze Risk analysis be divided into four subregion:

1) the Similkameen Valley, the Richter Pass to Keremeos, with Keremeos as the long-term base station;
2) South Okanagan - the U.S. Border to Okanagan Falls with Oliver as the long-term base station;
3) South-Central Okanagan - Okanagan Falls to Peachland with Penticton Airport as the long-term base station; and,
4) Central Okanagan-Peachland to Okanagan Centre with Kelowna Airport as the long-term base station.

Sufficient data were collected at both the short-term weather stations and the mobile temperature measuring points to achieve a standard error of estimate of the temperature deviations from the long-term station of less than 0.5°C for all of these subregions except for a few localities in the Similkameen Valley. Van Eimern (1968) suggested that the standard error should not exceed 0.5°C if maps are produced using 1°C intervals. Most clear nights during autumn in the Similkameen Valley are windy and mild, making it difficult to isolate those few nights that have a potential for an autumn freeze. The Similkameen Valley was mapped using two nights of data, accordingly, caution should be used in interpreting the autumn temperature results in this subregion.

Analysis of all of the temperature data permits the mapping of isotherms. These temperature deviation lines represent the expected temperature difference of a site from the appropriate long-term base station. The autumn freeze risk can then be estimated by determining the percentage of years that a temperature of -1°C or lower has occurred at that site on or before October 10. Statistics were calculated initially for the period of record at each base station. All areas represented by an isotherm of 0°C are assumed to have the same temperature and therefore the same freeze risk as the base station on clear calm autumn nights.

The freeze risk along all other isotherms is calculated by adding the value of the isotherm to the daily minimum temperatures at the appropriate base station. For example, the freeze risk along the +2°C isotherm would be calculated by adding 2°C to each daily minimum temperature at the base station and calculating the percentage of years in which the temperature would be -1°C or lower on a specific date. The temperature at the base station would have to drop to -3°C before the temperature along the +2°C isotherm fell to -1°C.

The classification for degree of freeze risk was derived as follows:

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 to 10%	0 to 1 yrs. in 10 yrs.
2	10 to 30%	1 to 3 yrs. in 10 yrs.
3	30 to 50%	3 to 5 yrs. in 10 yrs.
4	50%+	more than 5 yrs. in 10 yrs.

2.4.2 The Pattern of Autumn Freeze Risk

The Similkameen Valley, often windy and mild on autumn nights where it is clear, calm and cold elsewhere, has nights when freezes do occur, particularly in the lowest areas of the valley. The area near valley bottom, from the U.S. Border to Cawston has greater than a 50% Freeze risk. The region north of Olalla also has a 50% or greater freeze risk on October 10. West of Cawston, the narrow valley is more exposed to west winds resulting in milder temperatures and a decrease in freeze risk to less than 30% throughout most of the area. The lands above approximately 400 meters (1310 ft) throughout the Similkameen Valley have less than a 10% freeze risk.

The low lying areas from Frank to Richter Lakes have lower nighttime temperatures and more than a 50% chance of a -1°C freeze on or before October 10. Upslope, most of the remaining area has a higher temperature, and the freeze risk rating improves to 30 to 50% or Class 3.

It is evident from the South Okanagan maps that the valley sides are warmer by as much as 5°C. The highest freeze risk (over 50%) exists in the kettle-pocket area southwest of Osoyoos, in the low lying area south of Oliver and near White and Mahoney Lakes.

A 30 to 50% freeze risk as of October 10 is evident throughout the remainder of valley bottom areas from Osoyoos Lake to Inkameep Provincial Park and from north of Vaseux Lake to Okanagan Falls. A second region of 30 to 50% risk covers the large area to the west of the Okanagan Valley in the Park Rill Creek and Mahoney Lake area. Small pockets of this freeze risk class are evident east and west of Osoyoos Lake, in the lowest area of Inkameep Creek Valley and in the protected low hollows of Tugulnuit Lake.

Moderate overnight temperatures and a lower freeze risk occurs around most of Osoyoos Lake, along the Inkameep Creek Valley, upslope from the Okanagan River south of Inkameep Provincial Park and in the higher areas north of Vaseux Lake. The elevated and steeply sloped lands throughout the region and areas adjacent to Vaseux Lake have less than 10% freeze risk, a consequence of moderate overnight temperatures.

The coldest localities in the south-central Okanagan area are in the vicinity of Prather Lake, Penticton Airport and the valley occupied by McLean Creek just east of Okanagan Falls. Within the Summerland area and a similar area north of a low lying pocket south of Giant's Head are included within the Class 4 or greater than 50% freeze risk zone. Apart from these areas, the remainder of the region tends to fall into Classes 1 and 3. Small pockets of land from Okanagan Falls to Kaleden experience some cold air pooling with a 30 to 50% freeze risk. Within this class are major portions of the Garnett and Prairie Valleys near Summerland. Small pockets of this class are evident near Penticton Airport, just to the northeast of Penticton near Munson Mountian, and above a major frost pocket within the McLean Creek Valley. The remainder of the region has less than a 30% risk. Included in this warmer zone is most of land around Skaha Lake and east and west aspects around Okanagan lake. Large portions of the area surrounding these two lakes have an autumn freeze risk of less than 10% providing a favorable Class 1 environment.

The central Okanagan has extensive areas of high freeze risk in the Kelowna to Winfield area. Included within this zone are the large valley bottom area from the mouth of Mission Creek northward to Wood Lake, large level lands of East Kelowna behind the front benches and most of the Glenmore Valley. The west side of Okanagan Lake has the highest freeze risk, Class 4, in low lying areas in the Trepanier Creek Valley near Peachland and a low area near Westbank. A 30 to 50% freeze risk occurs on sites just above the Trepanier Creek and Westbank frost pocket and in a large area from Kelowna to Winfield. The warmer sloped lands and areas next to Okanagan Lake have a 10 to 30% risk of freeze on or before October 10 throughout most of Peachland, Okanagan Mission, Mt. Boucherie, the benches of Belgo and Rutland and in the area north of Kelowna along Okanagan Lake. The most steeply sloped localities in the vicinity of Peachland and Okanagan Mountain Provincial Park have less than a 10% risk.

Table 16
Autumn Freeze Risk

DIFFERENCE FROM BASE STATION ISOTHERMS	SEPT. 15	SEPT. 20	SEPT. 25	SEPT. 30	OCT. 5	OCT. 10	OCT. 15	OCT. 20	OCT. 25	OCT. 30	NOV. 4	NOV. 9	NOV. 14	NOV. 19	NOV. 24	NOV. 29
SIMILKAMEEN VALLEY - RICHTER PASS TO KEREMEOS **BASE STATION:** KEREMEOS LATITUDE: 49° 12'N LONGTITUDE: 119° 47'W ELEVATION: 430 METRES (1410 ft)																
-2°C	0	0	4.5	4.5	22.7	50.0	68.2	86.4	100	100	100	100	100	100	100	100
-1°C	0	0	4.5	4.5	9.1	22.7	40.9	63.6	86.4	95.5	100	100	100	100	100	100
0°C	0	0	4.5	4.5	9.1	9.1	22.7	31.8	54.5	68.2	81.8	95.5	95.5	100	100	100
+1°C	0	0	0	0	0	0	0	9.1	18.2	36.4	50.0	72.7	81.8	100	100	100
+2°C	0	0	0	0	0	0	0	0	4.5	36.4	45.5	63.6	72.7	86.4	100	100
+3°C	0	0	0	0	0	0	0	0	4.5	13.6	27.3	45.5	59.1	72.7	95.5	100
SOUTH OKANAGAN - THE U. S. BORDER TO OKANAGAN FALLS **BASE STATION:** OLIVER LATITUDE:49° 10'N LONGTITUDE: 119° 33'W ELEVATION: 305 METRES (1000 ft)																
0°C	3.2	12.9	19.4	25.8	51.6	64.5	80.6	93.5	96.8	100	100	100	100	100	100	100
+1°C	3.2	3.2	9.7	12.9	29.0	38.7	61.3	83.9	96.8	100	100	100	100	100	100	100
+2°C	3.2	3.2	9.7	9.7	25.8	32.3	54.8	77.4	93.5	93.5	96.8	100	100	100	100	100
+3°C	0	0	3.2	3.2	9.7	12.9	22.6	48.4	71.0	77.4	93.5	96.8	96.8	96.8	100	100
+4°C	0	0	0	0	0	3.2	12.9	35.5	54.8	64.5	87.1	96.8	96.8	96.8	100	100
+5°C	0	0	0	0	0	0	6.5	12.9	29.0	45.2	71.0	87.1	90.3	93.5	96.8	100
SOUTH OKANAGAN - OKANAGAN FALLS TO PEACHLAND **BASE STATION:** PENTICTON AIRPORT LATITUDE 49° 28'N LONGTITUDE: 119° 36'W ELEVATION: 342 METRES (1122 ft)																
DIFFERENCE FROM BASE STATION ISOTHERMS	SEPT. 15	SEPT. 20	SEPT. 25	SEPT. 30	OCT. 5	OCT. 10	OCT. 15	OCT. 20	OCT. 25	OCT. 30	NOV. 4	NOV. 9	NOV. 14	NOV. 19	NOV. 24	NOV. 29
-1°C	6.3	15.6	31.3	37.5	62.5	71.9	81.3	100	100	100	100	100	100	100	100	100
0°C	0	6.3	15.6	18.8	28.1	50.0	68.8	87.5	93.8	96.9	100	100	100	100	100	100
+1°C	0	3.1	9.4	12.5	15.6	28.1	40.6	59.4	81.3	87.5	100	100	100	100	100	100
+2°C	0	0	6.3	9.4	12.5	12.5	28.1	50.0	65.6	78.1	90.6	96.9	96.9	96.9	100	100
+3°C	0	0	3.1	3.1	3.1	3.1	12.5	25.0	43.8	62.5	71.9	87.5	96.9	96.9	100	100
+4°C	0	0	0	0	0	0	6.3	9.4	15.6	37.5	46.9	71.9	87.5	93.8	100	100
CENTRAL OKANAGAN - PEACHLAND TO OKANAGAN CENTRE **BASE STATION:** KELOWNA AIRPORT LATITUDE:49° 57'N LONGTITUDE:119° 23'W ELEVATION:471 METRES (1368 ft)																
0°C	16.1	32.3	45.2	61.3	80.6	90.3	90.3	100	100	100	100	100	100	100	100	100
+1°C	6.5	19.4	29.0	35.5	54.8	67.7	80.6	96.8	96.8	96.8	100	100	100	100	100	100
+2°C	3.2	9.7	16.1	19.4	35.5	48.4	67.7	83.9	96.8	96.8	100	100	100	100	100	100
+3°C	3.2	6.5	6.5	12.9	22.6	32.3	41.9	61.3	77.4	83.9	96.8	100	100	100	100	100
+4°C	3.2	3.2	3.2	6.5	12.9	16.1	22.6	32.3	64.5	71.0	93.5	96.8	100	100	100	100
+5°C	0	0	0	0	6.5	12.9	16.1	25.8	48.4	58.1	80.6	90.3	93.5	93.5	100	100

The Autumn Freeze Risk Maps are derived from October 10th Freeze Risk appearing in the Table. The figures within the table represent the percentage chance of having a -1°C freeze on or before the dates indicated.

The Freeze Risk Analysis for Kelowna Airport was extended using Kelowna CDA as a Base station. This was done by estimating the clear autumn night temperature difference between the two stations and applying that difference to the Kelowna CDA climate data. This procedure permitted the freeze risk analysis to be calculated based upon a longer data record.

2.4.2.1 Freeze Risks for Other Autumn Dates

Table 16 has been produced to enable a grower to assess the percentage chance of -1°C autumn freezes in five day intervals from September 15 to November 29.

This information will allow a grower who is attempting to increase the sugar content of the crop to estimate the additional risk involved in harvesting later in the autumn. The frequency table should also help a grower to decide whether to plant early or late maturing grape varieties. The following example will help to clarify the use of the freeze risk table. In the south end of the valley near Oliver, when is the most appropriate time to harvest a grape crop? The +2°C isotherm, representing the average clear calm autumn night temperature difference between the site of interest and the base station, in this case Oliver, passes near the example vineyard. The mapped value corresponds to the October 10 date on the freeze risk table. A delay of ten days to October 20 increases the freeze risk from 32.3% to 77.4%. Ten days earlier on September 30, the freeze risk decreases appreciably to 9.7%.

Areas of transition between the base stations require careful extrapolation. For example, the area near Okanagan Lake Provincial Park, between Peachland and Summerland is more than 5°C warmer than Kelowna Airport but less than 3°C warmer than Penticton Airport. The freeze risk on October 15 in such an area would be less than 16.1% but greater than 12.5%.

2.4.3 Microclimates Not Covered By Mapping

The scale of mapping within the Grape Atlas does not permit small microclimatic areas such as ravines and depressions to be mapped adequately. Subtle changes in the landscape can result in significant differences in minimum temperatures and the associated freeze risk. A brief discussion of some of these microclimates will illustrate the importance of considering these very small areas when selecting potential vineyard areas. Depressional land surfaces must be regarded as less favourable in that on calm nights heavier, cooler air accumulates in these areas. A small depression such as this can result in a significant lowering of temperature and an increase in freeze risk.

Frost pockets can also be created by road embankments, windbreaks, or ledges which dam the flow of air, thereby lowering temperatures and increasing freeze risk. Davis (1977) examined the feasibility of using wind machines for frost protection in the Okanagan Valley. He found that the spring freeze risk of certain frost prone microclimates could be adequately reduced using this method.

Some areas are also much warmer than expected. This is caused by downslope winds on clear autumn nights. These cold winds are the result of heavier air flowing downslope due to gravity. This flow of air mixes with warmer air above and warms these sloping lands. Some of the areas where these moderating local winds occur are in the Belgo region near Mission Creek in Kelowna, much of the region near Peachland, and at the west end of the Prince Valley near Summerland.

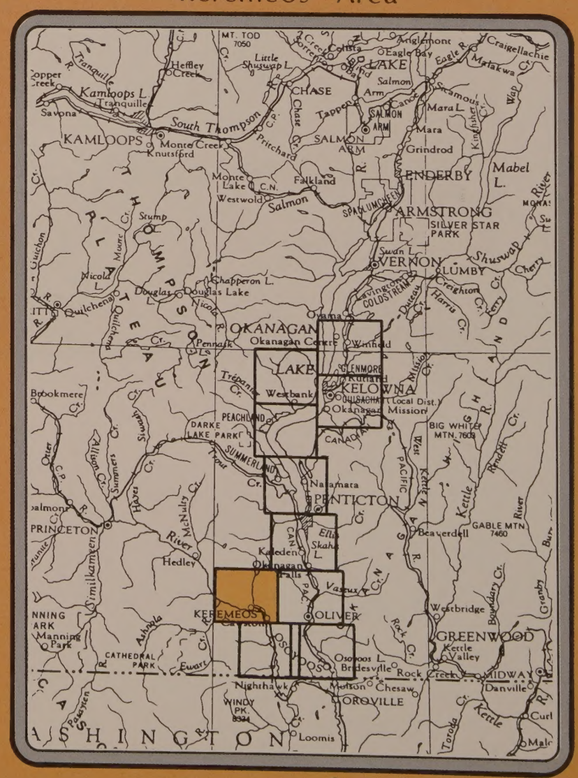
Light Autumn Frost Damage to Leaves

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000

AUTUMN FREEZE RISK

Keremeos Area



Location Map

49°20'00"

120°00'00"

KEREMEOS FORKS
INDIAN RESERVE 12 A

Keremeos Forks
Indian Reserve 12

KEREMEOS COLUMNS
PROVINCIAL PARK

ASHNOLA
INDIAN RESERVE 16

ALEXIS
IR 9

ASHNOLA IR 10B

BLIND
CREEK
IR 6

Keremeos

Cawston

Village Limits

Trailer
Park

Poultry Farm

Fairgrounds

Abandoned

Transformer
Station

Lowe
Slough

Tp 52

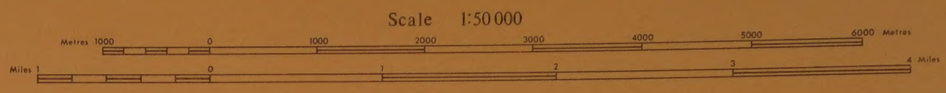
Tp 52

49°10'00"

119°43'00"

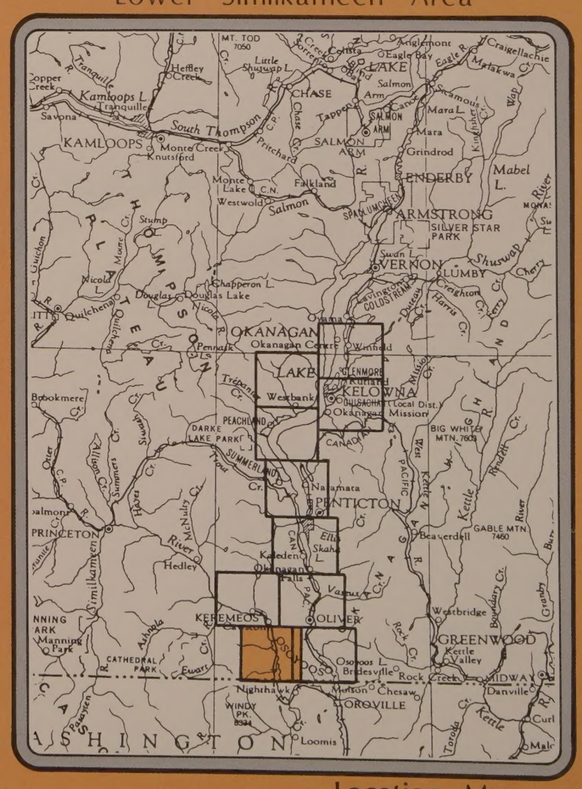
Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000



AUTUMN FREEZE RISK

Lower Similkameen Area



Location Map

49°10'00"

119°52'00"

ASHNOLA

INDIAN RESERVE 13

PROVINCIAL FOREST

NARCISSE'S FARM

LOWER SIMILKAMEEN IR 2

BURRINGTON NORTHERN

OKANAGAN PROVINCIAL FOREST

Mount Kobau

Golf Course

Richter L.

Frank L.

SIMILKAMEEN RIVER

SKEMEOSKUANKIN INDIAN RESERVE 7

SKEMEOSKUANKIN INDIAN RESERVE 8

RICHTER MOUNTAIN

OKANAGAN PROVINCIAL FOREST

Chopaka

Chopaka Customs

CANADA

BRITISH COLUMBIA

49°00'00"

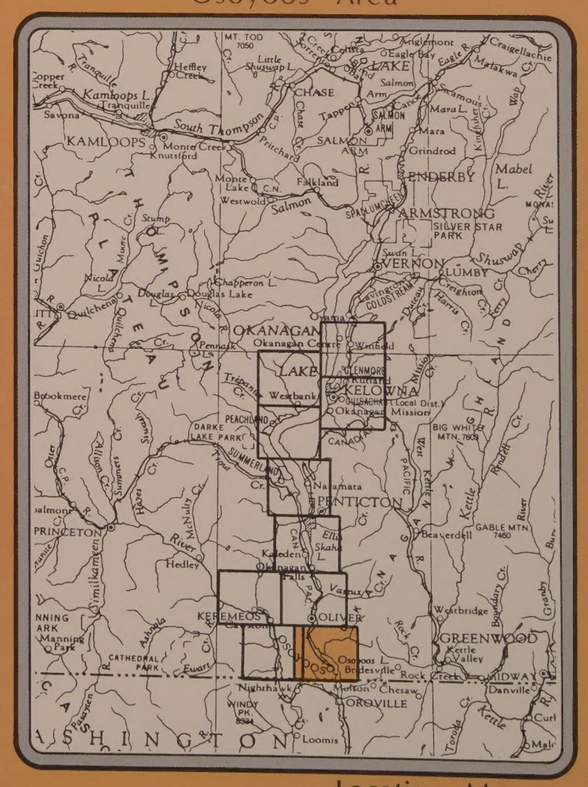
119°35'00"

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000

AUTUMN FREEZE RISK

Osoyoos Area



Location Map

49°10'00"

119°38'00"

INDIAN RESERVE 1

INDIAN RESERVE 1

OKANAGAN

CANADIAN PACIFIC

OSOYOOS LAKE

OKANAGAN FOREST

OKANAGAN PROVINCIAL FOREST

OKANAGAN MT KRUGER PROVINCIAL FOREST

HAYNES POINT PROV PARK

Osoyoos

Haynes

Richter L.

Kilpoola Lake

Tinhorn Creek

Hester Creek

Testalinden

Inkaneep

McCuddy Creek

Baldy Creek

Shuttleworth Creek

Hurtree Creek

Swamp Creek

Richter Pass

Golf Course

Dump

Ecological Reserve 83

Lacey Point

Marina

Museum

Community Center

Campsite

Trailer Park

Radio Tower

Gas Pipeline

Orchard

Vineyard

Motel

Auto Wrecker

Theatre

Auto Wrecker

Boat Ramp

Pump House

Anarchist Lookout

Customs

City Limits

Gate

Sluice Gate

Transformer Sta.

Tp 51

Tp 47

L 2450s

L 24508

L 2709

2186

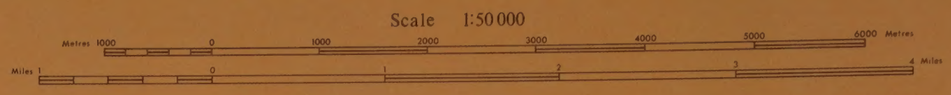
2603

49°00'00"

119°21'00"

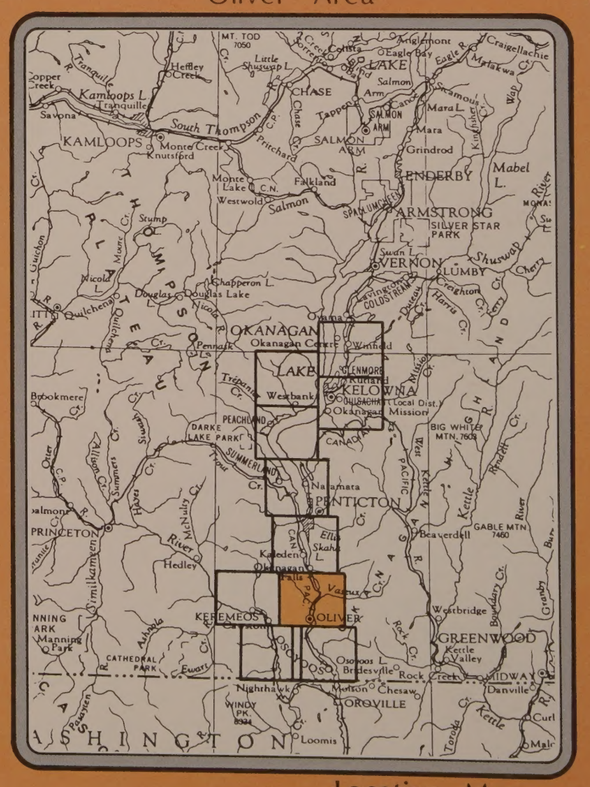
Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000



AUTUMN FREEZE RISK

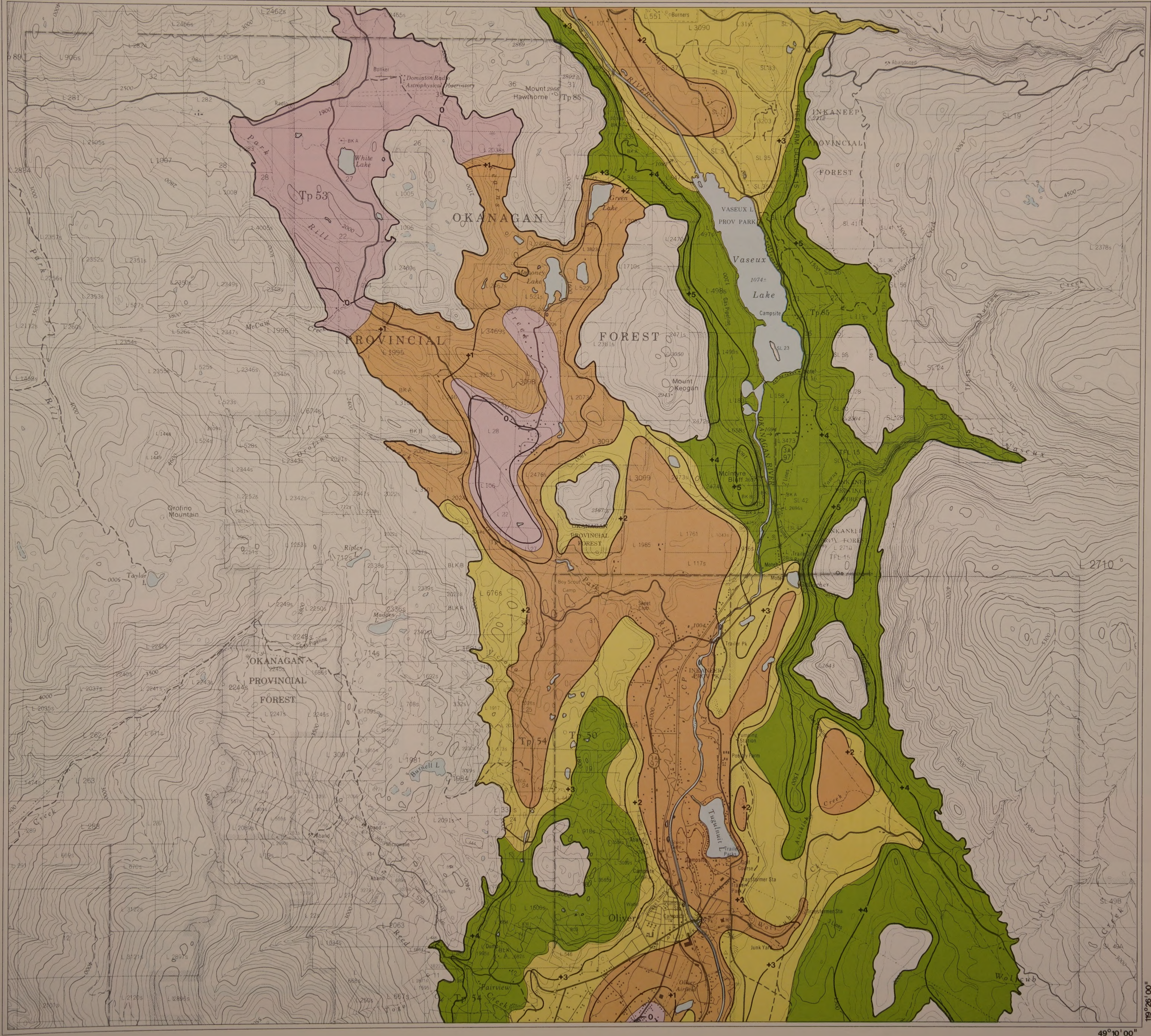
Oliver Area



Location Map

49°20'00"

119°43'00"

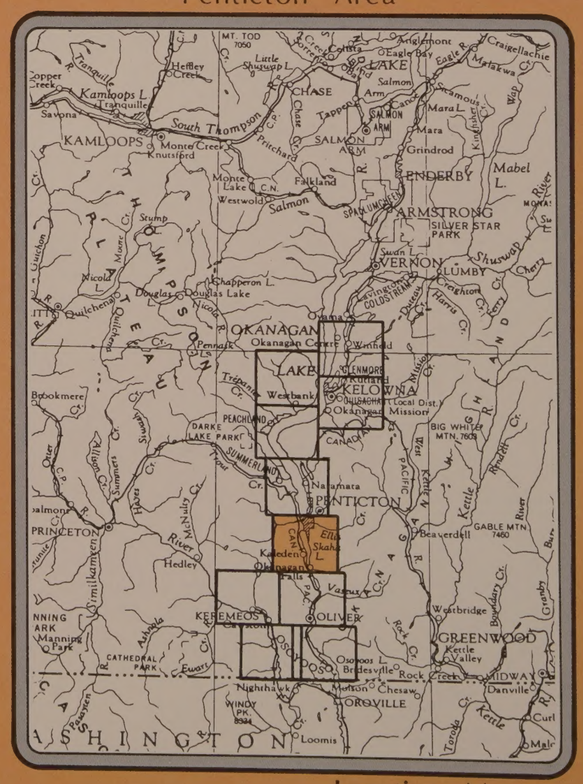

OKANAGAN
PROVINCIAL
FOREST
Tp 53
Tp 85
Tp 54
Tp 50
Park Rill
White Lake
Bunker
Dominion Radio Astrophysical Observatory
Mount Hawthorne
Green Lake
Mahoney Lake
McCall Creek
Orofino Mountain
Taylar L
Riplex L
Madden L
Burnell L
Oliver
Fairview Creek
Vaseux Creek
Vaseux Lake
VASEUX L PROV PARK
Campsite
Mount Keogan
McIntyre Bluff
OKANAGAN RIVER
INKANEEP PROVINCIAL FOREST
TREE FARM LICENCE 15
TFL 15
Abandoned
Burners
Gas Pipeline
Trailer Park
Golf Course
Transformer Sta
Junk Yard
Motel
Boy Scout Camp
Skeet Club
Tugulnuit L
Wolfcub Creek
Aeriskick Ck
Reed Creek
Oliver Airfield
CP INRANEER PARK
Pumping Station
Pottery Farm
Microwave
Abandoned
Tailings
Dump
Campsite
Trailer Park
Golf Course
Transformer Sta
Junk Yard
Motel
Trailer Park
Boy Scout Camp
Skeet Club
Trailer Park
Pumping Station
Pottery Farm
Abandoned

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000

AUTUMN FREEZE RISK

Penticton Area



Location Map

49°30'00"

119°45'00"

OKANAGAN PROVINCIAL FOREST

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PENTICTON

PENTICTON INDIAN RESERVE 1

OKANAGAN

L 2710 PROVINCIAL FOREST

SKAHA LAKE

Shingle Creek

Skaha Creek

Penticton Airport

Skaha Park

Marron River

Marron Valley

OKANAGAN PROVINCIAL FOREST

Okanagan Falls

Kaledon

Christie Memorial Park

Mount McLellan

OKANAGAN FALLS PROVINCIAL PARK

Shuttleworth Creek

Ellis Creek

Penticton Creek

Thomas Creek

Derenzy Lake

Aeneas Lake

Marron Lake

Trout Lake

Killey Lake

Fairleigh Lake

Golf Course

Trailer Park

Campsite

Marina

Pumphouse

Sawmill

Gas Pipeline

Hospital

Museum

Senior Citizens Home

Amusement Park

Weigh Scale

Strip Mine

Dump

Water

Zoo

Gate

Trans Sta

Cement Plant

Creek

Lake

Park

Mountain

Flat

Valley

Forest

Provincial

Indian Reserve

Falls

Marina

Campsite

Airport

Golf Course

Trailer Park

Pumphouse

Sawmill

Weigh Scale

Strip Mine

Dump

Water

Zoo

Gate

Trans Sta

Cement Plant

Hospital

Museum

Senior Citizens Home

Amusement Park

Christie Memorial Park

Mount McLellan

OKANAGAN FALLS PROVINCIAL PARK

Kaledon

Pumphouse

Sawmill

Trailer Park

Campsite

Marina

Gas Pipeline

Water

Creek

Lake

Park

Mountain

Flat

Valley

Forest

Provincial

Indian Reserve

Falls

119°28'00"

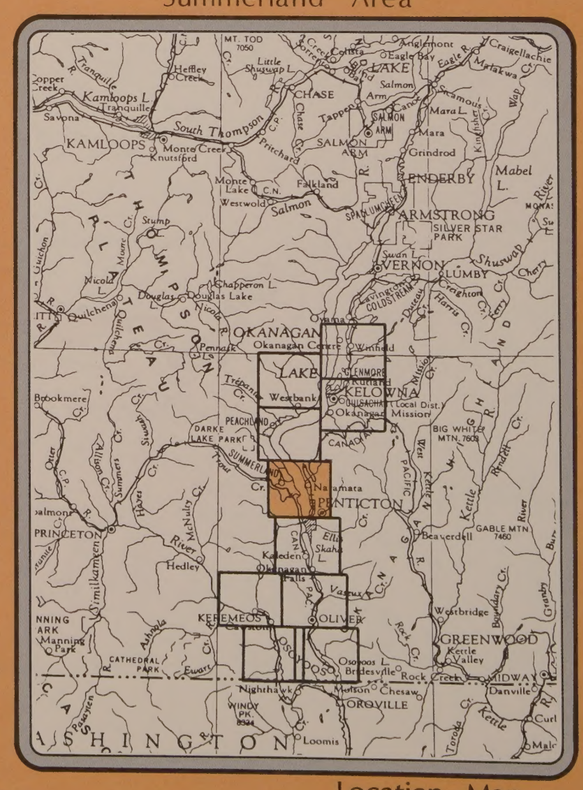
49°20'00"

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000

AUTUMN FREEZE RISK

Summerland Area



Location Map

49°40' 00"

119°47' 00"

OKANAGAN LAKE

OKANAGAN PROVINCIAL FOREST

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT
OSOYOOS DIVISION OF YALE LAND DISTRICT

Summerland

Naramata

PENTICTON

PENTICTON INDIAN RESERVE 3A

INDIAN RESERVE 1

OKANAGAN PROVINCIAL FOREST L 4701

KICKININEE PROVINCIAL PARK

MUNSON MOUNTAIN PROV. PARK

MOUNT CONKLE

BLUE MOUNTAIN

Mount Kobau

Mount Campbell

East Penticton

Trout Creek

Penticton Creek

Ellis Creek

Brent Lake

Naramata Creek

Arawana

Adra

Glenfir

Faulder

Narcisse Lake

Sun-Oka Provincial Park

Experimental Farm

Winslow

Kettle Valley Railway

Kettle Valley Railway Trail

Golf Course

Trailer Park

Campground

Rest Area

Lookout

Gate

Pumphouse

Marina

Motel

Park

Garrett Point

Cement Plant

Pumphouse

Breakwater

Manitou Provincial Park

Kettle River Reserve

Mission Creek Reserve

Mount Kobau

Mount Kwala

Mount Campbell

Mount Matron

Turnbull Creek

Radio

Television 104

Trans

Fire Lookout

Abandoned

Water

Pipeline

Fence

Fire Trail

Fire Road

Creek

Lake

Flume

Ditch

Dump

Quarry

Pit

Arena

Tower

Station

Research Station

Experimental Farm

Provincial Park

Indian Reserve

Forest

Mountain

Mount

Point

Bay

Grove

Park

Marina

Campground

Rest Area

Trailer Park

Golf Course

Lookout

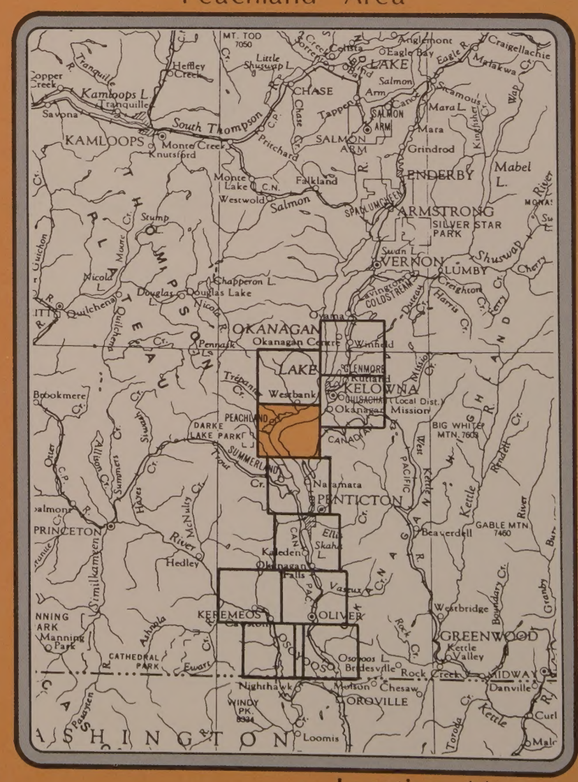
Gate

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000

AUTUMN FREEZE RISK

Peachland Area



49°50'00"

119°49'00"

Mount Law

Mount Drought

Mount Coldham

McCall Lakes

Spring L.

PINCUSHION MTN.

Trepanier

Peachland

Rattlesnake Island

Squally Point

Greata

Mount Eneas

Antlers Beach Provincial Park

Trailer Park

Lookout

Marina

Westbank

Gellatly

Camp

Tree Nursery

Reservoir

Trailer Park

Poultry Farm

Sawmill

Pk

Flume

Gas Pipeline

Pump

Mill

Trail

Creek

Lake

Park

OKANAGAN

LAKE

1123±

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PEACHLAND DISTRICT MUN.

WILD HORSE CANYON

TP 28

OKANAGAN MOUNTAIN

PROVINCIAL PARK

OKANAGAN LAKE PROVINCIAL PARK

Okanagan Mountain Microwave Tower

Baker Lake

Norman L.

Gemmill Lake

Chute Lake

Commando Bay

VALLEY

L 2711

Qio

+2

+3

+4

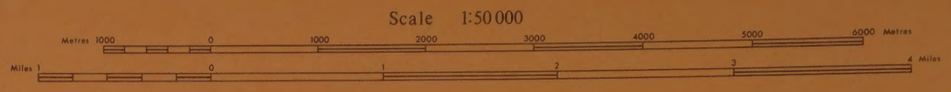
+5

49°40'00"

119°32'00"

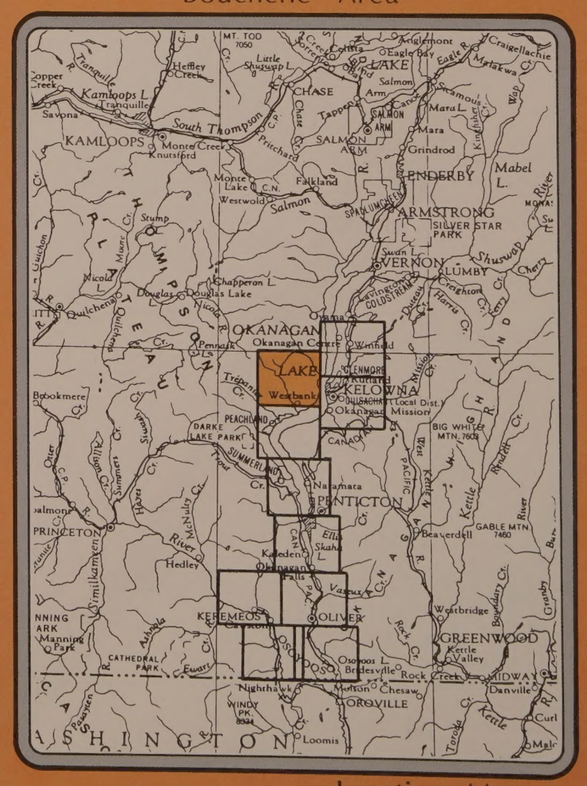
Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000



AUTUMN FREEZE RISK

Boucherie Area



Location Map

50°00'00"

119°49'00"

WEST OKANAGAN PROVINCIAL FOREST

PROVINCIAL FOREST

TSINSTIKEPTUM INDIAN RESERVE 9

TREE FARM LICENCE 9

Dobbin L.
Iklahi Lake
Bit Creek
Lily L.
Paynter Lake
Lambly Lake
Lambly Ck
Mount Swite
Hidden Creek
Hayman L.
Banana L.
Jackpine L.
Powers
Carrot Mountain
McDougall Creek
Rose Valley Lake
Water 3866
Control Gate & Dam
Shewell Ck
Reid Ck
Rogers Creek
Faulkner Creek
Trailer Park
Tree Nursery
Shannon Lake
Mount Boucherie
Mount CLEMENTS
Mount LAST
Mount Miller
Ski Lift
Television
Hill Creek
Jack Creek
Glenrosa
Pumphouse
Dump
Trans
Gate
Ditch
Junk Yard
Asphalt Plant
Cement Plant
Water
Poultry Farm
Underground Reservoir
PARK

119°32'00"

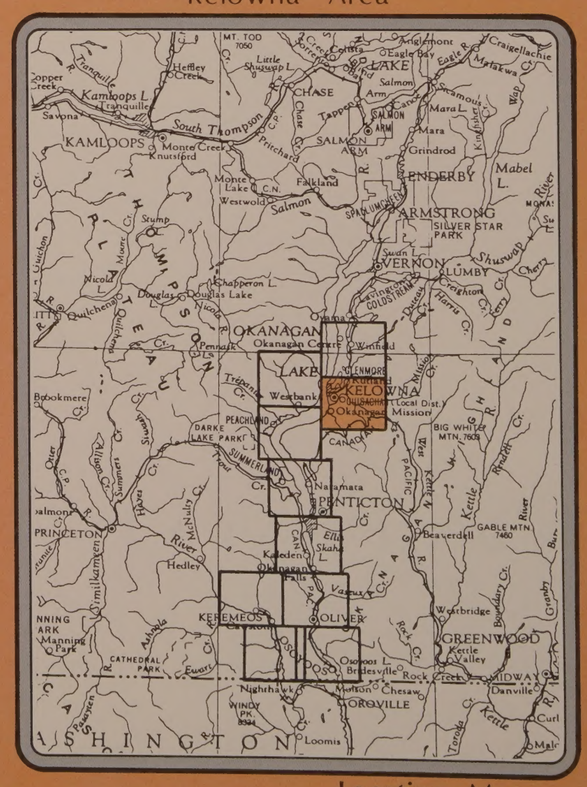
49°50'00"

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000

AUTUMN FREEZE RISK

Kelowna Area



Location Map

49°56'00"

119°32'00"

KELOWNA

Westside

Okanagan Mission

Rutland

East Kelowna

Mount Knox

Mount Dilworth

Black Knight Mountain

Knox Mountain Park

Manhattan Point

Sutherland Hills Prov. Park

Mission Beach Prov. Park

Rutland Community Provincial Park

Okanagan Lake

Mission Creek

Bulman Creek

Brother Creek

Hydraulic Creek

Jack Smith Lake

Fraser L.

Renkler Creek

Tp 25

Tp 27

Tp 28

Tp 29

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

49°46'00"

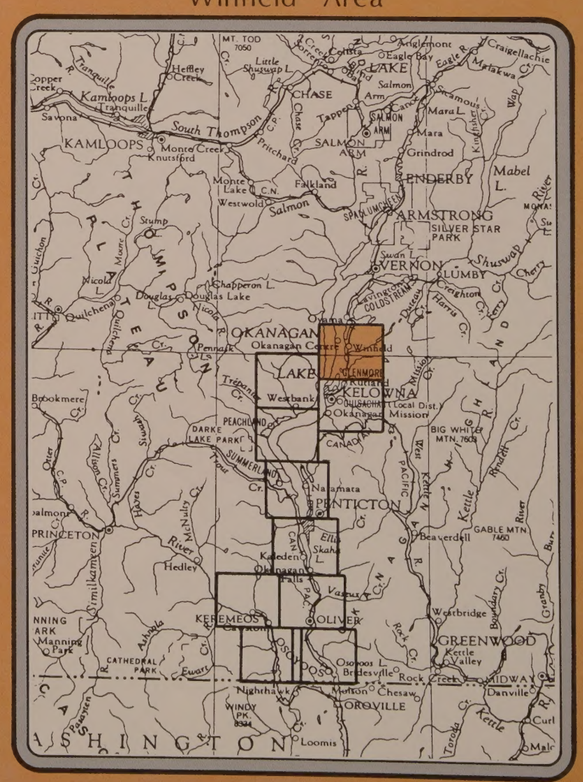
119°15'00"

Class	Freeze Risk	Frequency of Damaging Freezes
1	0 - 10 %	0 to 1 yrs. in 10 yrs.
2	10 - 30 %	1 to 3 yrs. in 10 yrs.
3	30 - 50 %	3 to 5 yrs. in 10 yrs.
4	50 % +	more than 5 yrs. in 10

Scale 1:50 000

AUTUMN FREEZE RISK

Winfield Area



Location Map

50°06'00"

119°32'00"

OKANAGAN PROVINCIAL FOREST

TREE FARM LICENCE 9

WEST OKANAGAN PROVINCIAL FOREST

TFL 9

OKANAGAN LAKE

WOOD LAKE

Nahun

Caesars

Wilson Landing

Traders Cove

Okanagan Centre

Woodsdale

Winfield

Vernon

Ellison

Ellison Lake

DUCK LAKE INDIAN RESERVE 7

Kelowna

Tp 20

Tp 21

Tp 23

Tp 24

Echo Lake

Echo Creek

WRINKLY FACE 4750 CLIFF

Clark Creek

Horse Creek

Gravel Creek

Rowbiggee Creek

Kelowna City Limits

Lightblue Lake

Walroy Lake

Robert Lake

Prostill

Horseshoe Gulch

Girl Guide Camp

Cinnabar Creek

Dippery Creek

Bible Camp

Trailer Park

Marina

Motel

Pumping Station

Water Pipeline

Gas Pipeline

Underground Reservoir

Abandoned

Senior Citizen Home

Recreation Centre

Lumber Yard

Kelowna Gate

Sawmill

2 Reservoirs

Settling Ponds

Distillery

Air Beacon

Dump

Pumping Station

Reservoir

Kelowna Airport

Tree Nursery

Clubhouse

City Limits

Trailer Park

1123±

49°56'00"

119°15'00"

Ice caused by Overhead Irrigation

2.5 CLIMATIC CONDITIONS PRODUCING WINTER DAMAGE

Winter damage to grapevines occurs due to the interaction of a large number of factors. The extent and amount of damage to vines which might be expected during an extremely cold winter depends upon climatic factors, the grape variety planted, soil type, and the level of farm management. The climatic factors contributing to problems of winter damage depend primarily upon extreme winter minimum temperatures, snow cover, wind and early autumn freezes.

In Washington State a threshold temperature of -23°C has been identified as the temperature at which injury to both buds and trunks begins to occur to the more sensitive European grape varieties (Tukey and Clore, 1972). While the mid winter -23°C threshold begins to damage the vines early winter cold can also harm the grapes. Paroschy and Meiring (1978) determined that grape leaves must remain on the vine for three to four weeks after the harvest to permit the build-up of carbohydrate reserves in the storage tissue and natural protective waxes. This accumulation and concentration of carbohydrates and waxes is responsible for the grape plant becoming winter hardy (Paroschy, 1978). A 1955 cold wave enveloped the Okanagan Valley beginning on November 11th and resulted in considerable damage to grapevines as temperatures fell to -17°C at Summerland C.D.A., Penticton Airport and Oliver. This severe arctic outbreak so early in the winter, resulted in a 78% drop in production from the previous year throughout the region.

A temperature of -12°C on or before November 15th has been identified as the temperature which will begin to cause damage to grapevines early in the winter. More severe damage to vines occurs as winter temperatures drop to -20°C. Work done by Meiering et al. (1980) on Gewurtztraminer grapes in Ontario revealed that extensive mechanical damage to phloem and xylem layers of the grapes was observed at -25°C.

The funnelling of wind by the narrow southern interior valleys is responsible for strong and persistent winds during both the growing season and winter months. The Similkameen Valley is oriented east to west near Keremeos, and north to south in the Cawston area, which tends to funnel winds in those directions. Wind is also increased and funnelled north or south within the Okanagan Valley, particularly in the area from Osoyoos to Westbank. Northward in the Kelowna area, a widening of the valley leads to a decrease in wind speeds. Persistent high winds during the growing season may delay grape maturity and increase potassium levels into the phloem and the grape berries (Freeman, Kliewer and Stern, 1982). Winter winds are also an important factor with respect to grape growing. The elevated sloping lands, although milder, are more exposed to high winds and often have their protective snow cover removed as a result of drifting. Damage on these sites is a function of not only winter cold, but also the high winds and lack of snow cover. The grapevines become more exposed to the harmful effects of the drying winter winds and cold temperatures. A lack of snow cover during arctic outbreaks encourages freezing of the soil and subsequent desiccation to the grapevines.

Shelterbelts or windbreaks have been used throughout the world as a means of protecting crops and soil from the detrimental effects of strong winds (World Meteorological Organization, 1964). Areas where winds cause significant problems include much of the Similkameen Valley and sloping lands in the south Okanagan, most particularly the east side of the valley south of Oliver. The main valley from Okanagan Falls to Westbank also experiences high winter winds.

2.5.1 Synoptic Conditions Resulting In Winter Damage To Grapevines

The weather conditions that lead to winter damage of grapevines within the Similkameen and Okanagan Valleys are the result of severe outbreaks of very cold air masses originating in the continental regions of Canada's Arctic. Often the arctic air flowing into the Okanagan is not cold enough to cause damage to perennial crops such as grapevines. On occasion, however, the major dome of the cold air mass flows southward over the province. These severe arctic outbreaks occur as a result of the formation of a strong high pressure ridge just to the west of British Columbia, combined with the formation of a cold and heavy arctic air mass over the Yukon and Alaska. These conditions produce a strong cold northerly flow in the upper air which can bring the arctic front southward through the Okanagan and Similkameen Valleys. After the passage of the arctic front, the cold air often dries and deepens resulting in a further lowering of already severe temperatures. It is during these synoptic situations that most of the winter damage has occurred to vineyards in the study area.

2.5.2 Observations of Recent Winter Damage To The Okanagan and Similkameen Grape Crop

The most recent winter of serious widespread damage to grapevines was that of 1978/79. An arctic front passed south of the region on December 26th. After the passage of the front, a strenghtening of the upper arctic ridge occurred. The result was a deepening of the cold air mass over the region, temperatures lowered and winds from the north increased. Temperatures during December, 1978 fell to -25°C at Keremeos, -25°C at Osoyoos, -26°C at Oliver, - 21°C at Penticton Airport, -23°C at Summerland CDA, and from -22°C to -31°throughout the Kelowna area.

These low temperatures, in combination with strong winds and a light snowpack all contributed to damage to the grapevines. Damage to vines was further compounded by the cool late summer weather conditions and a heavier than usual grape crop, resulting in a late grape harvest. A severe mid November freeze killed grape leaves shortly after harvest and before the vines had the opportunity to become winter hardy (Denby and Vielvoye, 1979). Damage ranged from moderate to severe throughout most areas of the Okanagan and Similkameen. A complex pattern of damage was revealed upon examination of vineyards during the next spring and summer. More than 50% of the vines in the Similkameen Valley were damaged severely. Throughout the southern part of the Okanagan Valley, in areas south of Okanagan Falls more than 50% of vines showed severe winter damage. Although temperatures in the south Okanagan and Similkameen were not as low as in the areas north of Summerland, higher winds and less snow cover associated with sandy soils all contributed to more vine kill in the southern districts. These conditions resulted in a substantial amount of mechanical freeze damage and subsequent dehydration of vine root systems on sandy soils.

In exposed localities as far north as Summerland and Westbank more than 20% of the vines were severely damaged. East Kelowna, a region away from the lake and not exposed to strong winds, despite having temperatures of -26°C, had less damage. The damage to vines was approximately 10% in the East Kelowna area. Table 17 reveals the winter conditions that resulted in most of the observed damage.

Table 17
1978/1979 Winter Conditions

Climate Station	Extreme Winter Minimum Temperature	December 31 Snowpack
Keremeos	-24.5°C	6 cm
Osoyoos	-25.0°C	Trace
Oliver	-25.5°C	0 cm
Penticton Airport	-20.8°C	2 cm
Summerland C.D.A.	-22.5°C	6 cm
Kelowna Airport	-30.5°C	15 cm
Keloka BCMAF	-26.0°C	not measured
Okanagan Centre	-25.5°C	not measured

The winter of 1972/73 also produced considerable damage to grapevines. Overall production was reduced by 577 tonnes from the previous year. Severe early autumn freezes during the period September 17 to 26th, killed grape leaves and prevented grapevines from becoming winter hardy. This was a contributing factor to the most severe damage observed in the Oliver to Osoyoos area (Denby and Vielvoye, 1973).

In 1972, 75% of the grapevines in the Similkameen Valley were damaged. This was attributed to temperatures of -20°C on December 7th, -22°C on January 7th and sparse snow cover. Early autumn freezes that occurred in the Okanagan Valley were not apparent within the Similkameen Valley.

The 1972/73 pattern of grapevine winter damage in the Oliver and Osoyoos area was much different from that experienced in 1978/79. Unlike 1978/79, most damage was observed in areas prone to cold air pooling. The coldest temperature experienced at Oliver was -21°C on January 5th. It is apparent that the major reason for the damage in the south Okanagan was the very early severe freezes that occurred in the mid to late September. Localities experiencing most damage in Summerland to Peachland area, were situated approximately 180 meters (600 ft) above and several kilometers from the lake. Even though temperatures as low as -19°C were observed, the main reason for the damage evident in the following spring was the early autumn freeze in 1972.

The pattern of winter damage in the Kelowna to Westbank area was also not the same as that observed in 1978/79. Most damage during 1972/73 in this area was not in the more exposed localities but in areas having the poorest air drainage (frost pockets). Vines in the Okanagan Mission area, typical of a site with good air drainage, showed the least amount of observed damage. Temperatures fell to -24°C at Kelowna Airport on December 8th and again on January 8th to 10th. Kelowna Pollution Control Centre had extreme minimums which dropped to -19°C on December 8th and January 4th, 6th, and 10th. These temperatures alone cannot account for the winter damage experienced in the grape growing areas around Kelowna. Instead the early autumn freezes, with temperatures from -3°C to -6°C on September 27th injured green canes and did not permit many grapevines in the more freeze prone localities to become winter hardy. The moderately cold winter temperatures, did not cause problems to grapevines but compounded the problem arising from the early autumn freezes.

Prior to 1972, other cold winters have also caused problems to the grape crop. After the very cold winter of 1968/69 overall Okanagan and Similkameen grape production was reduced by 72% from the previous year. Extremely low temperatures were recorded late in December and throughout the month of January. The coldest temperatures were recorded in the Similkameen Valley (-30°C) and in areas away from Okanagan Lake. Within the Kelowna area, Kelowna Airport, some distance from Okanagan Lake, had a temperature as low as -36°C on December 30th. Closer to the lake, Kelowna Bowes Street had an extreme minimum temperature of -29°C on the same date. Kelowna C.D.A., away from the moderating affects of Okanagan lake, had an extreme minimum of -32°C on December 30th. Fortunately, heavy snowpacks served to protect the grape vines in most areas north of Penticton. The amount of snow on the ground at the end of December varied from 5 cm at Keremeos and Osoyoos, to 10 cm in Oliver region, 15 to 18 cm in the Penticton to Summerland area, and 25 to 29 cm in the snowier less windy Kelowna area. Winter damage to vine roots may well have been more severe had it not been for the protection provided by the insulating layer of snow.

The winter of 1949/50 was also severe, reducing production to 42% of the previous year. Mann, Keane and Lapins (1952) observed that the very cold temperatures of from -27°C to -32°C on January 17th, 18th, 24th and 25th, caused considerable problems to the tree fruit industry, throughout the Okanagan Valley. This damage occurred despite substantial amounts of snow cover throughout January 1950. Penticton Airport had 13 cm of snow on the ground on January 31, 1950. Most damage to orchards occurred at the higher elevations away from the moderating affect of Okanagan Lake, in areas of poor air drainage.

An extensive network of climate stations operated in 1971/72 by the British Columbia Ministry of Environment throughout the Okanagan and Similkameen Valleys permitted a more thorough analysis of the spatial variation in winter temperatures. During the winter of 1971/72, the Similkameen Valley experienced extreme winter minimum temperatures that were slightly lower than throughout most of the Okanagan Valley. Temperatures fell to -23°C to -24°C throughout the Similkameen Valley. Within the Okanagan Valley, the data collected during the winter of 1971/72 demonstrated the moderating influence of Okangan Lake. This moderating influence was most pronounced in the Summerland area. The extreme minimum temperatures recorded at Jones Flat and Summerland C.D.A., close to the lake, were approximately -22°C. Faulder, a few kilometres west of Summerland at a higher elevation and further inland, recorded an extreme winter minimum temperature of -27°C.

Much the same pattern of extreme winter minimum temperatures was evident in the Peachland to Kelowna area. Sloping lands next to the lake recorded temperatures from -19°C to -22°C, while as little as one kilometre inland in the lowlands of Mission and Trepanier Creeks, cold air pooling and a lack of moderation by Okanagan lake permitted temperaturs to fall to -25°C to -27°C. Further inland, in areas such as Kelowna Airport, the 1971/72 extreme winter minimum temperature dropped to -30°C. Most areas away from the lake in the Kelowna area, though colder than the sloping lands next to the lake had winter minimums of -24°C to -26°C.

The large open lakes influence the Okanagan Valley's winter climate in two ways. The warmer water directly moderates the air in close proximity to a lake. Also, moisture introduced into the atmosphere from the larger lakes results in the formation of valley cloud, this prevents or hinders additional cooling of the air mass at night.

Extreme minimum temperatures observed during the winter of 1971/72 in the Osoyoos area revealed the tendency for milder temperatures throughout this portion of the valley. This is likely in response to the persistent winds which blow during arctic outbreaks. This mixing affect prevents winter minimum temperatures from falling to extremely low values in the more exposed localities. The sloping valley sides for example recorded extreme winter minimums from -18°C to -21°C, with the most moderate temperatures recorded around Osoyoos. Valley bottom sites north of Osoyoos, prone to cold air pooling, were colder with temperatures falling to -22°c to -24°C. Localities away from the main valley were colder still, with a climate station within the Richter Pass experiencing an extreme winter minimum temperature of -28°C.

2.5.3 Frequency Analysis of Extreme Winter Minimum Temperatures Damaging to Grapevines

The temperature thresholds that have been identified for the purposes of this study are as follows: A temperature of -23°C after November 15th or -12°C before this date has been isolated as the temperatures corresponding to the initiation of damage to grapevines. In addition, moderate to severe damage to grapevines is assumed to correspond to a temperature of -26°C occurring at any time during the winter.

An extreme value analysis (Gumbel, 1960), a statistical technique which permits the determination of the recurrence interval of certain designated temperature extremes, has been applied to climatic data throughout the Okanagan and Similkameen Valleys. This statistical technique has been used to determine the expected frequency of the -26°C critical temperature, and has been based upon the occurrences of historical winter extreme minimum temperatures of -26°C or lower. A separate analysis has been undertaken upon extreme winter minimum temperatures at weather stations throughout the region, to determine the number of occurrences of a temperature of -12°C on or before November 15th, or a temperature of -23°C thereafter. Table 18 shows the expected number of occurrences of these temperature thresholds.

Table 18
Frequency of Extreme Winter Minimum Temperatures Throughout the Okanagan and Similkameen Valleys

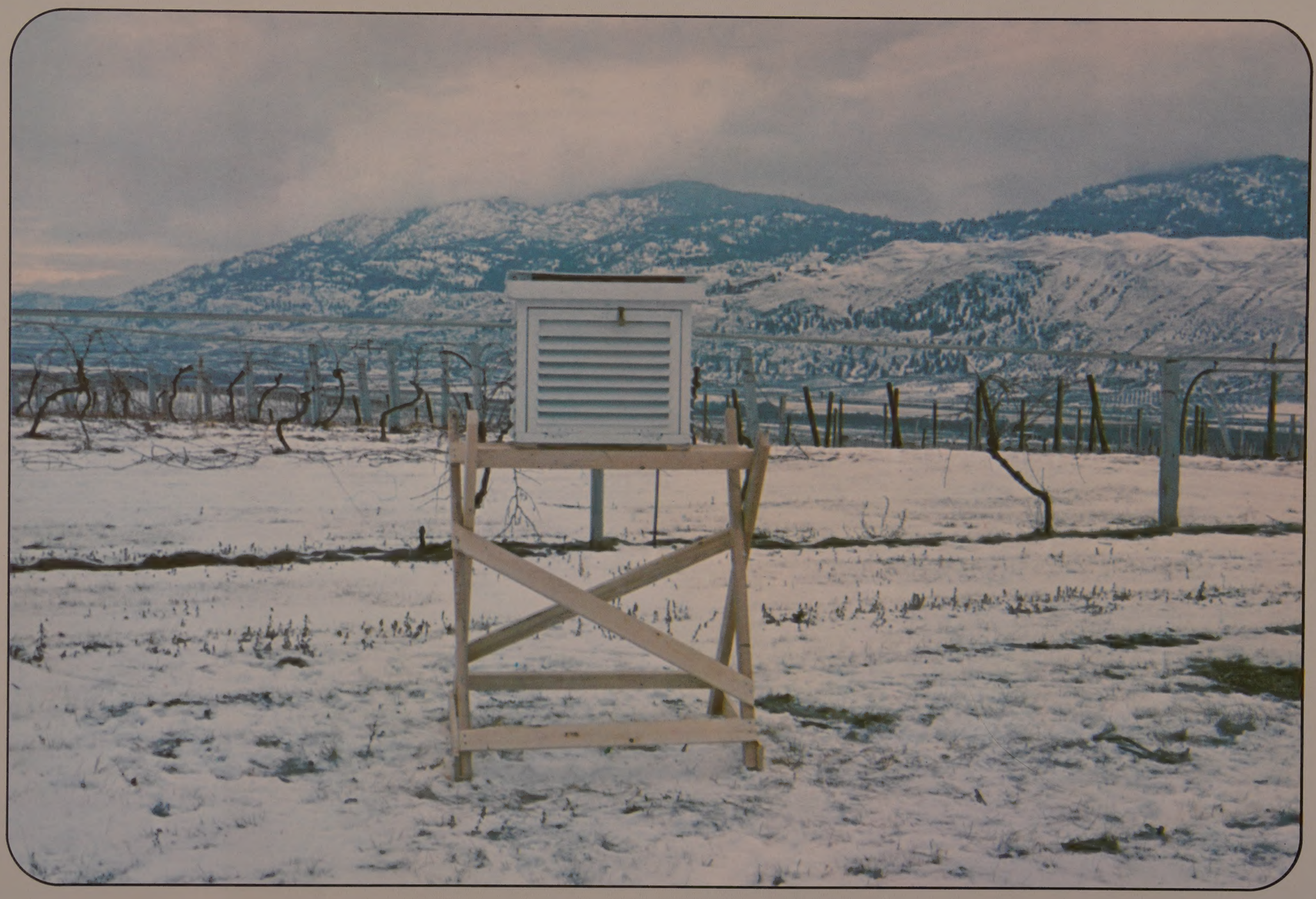
Climatic Station	Recurrence Interval of Temperatures Less Than ⁻26°C	Observed Frequency of Occurrences of ⁻12°C Before Nov. 15 or ⁻23°C After Nov. 15
Keremeos	1 winter in 7 yrs.	1 winter in 2 yrs.
Osoyoos	1 winter in 28 yrs.	1 winter in 4 yrs.
Oliver	1 winter in 8 yrs.	1 winter in 3 yrs.
Penticton Airport	1 winter in 27 yrs.	1 winter in 4 yrs.
Summerland C.D.A.	1 winter in 16 yrs.	1 winter in 3 yrs.
Kelowna C.D.A	1 winter in 3 yrs.	1 winter in 2 yrs.
Okanagan Centre	1 winter in 12 yrs.	1 winter in 47 yrs

The Similkameen Valley is colder in winter than most of the Okanagan Valley, as the Similkameen does not have the moderating benefit of any large lakes. The Keremeos weather station has a recurrence interval of a -26°C temperature in one winter every seven to eight years, the -12°C early winter or -23°C mid winter temperature threshold has occurred in twenty-one winters in forty-eight years or approximately 1 winter every 2 years.

Southern sections of the Okanagan Valley, despite being away from the largest lake in the region, generally have the mildest winter temperatures. Osoyoos may expect the least number of occurrences of winter temperatures causing damage to the grape crop. The Oliver climate station is located in a cold, low lying, site reflecting the tendency for a greater number of occurrences of grape damaging winter temperatures. This station is not representative of most of the vineyards around Oliver, as most are located in milder valley side locations. Penticton Airport illustrates the advantage gained by being close to Okanagan Lake in that the number of occurrences of grape damaging winter temperatures is less than the low-lying areas around Oliver.

Summerland C.D.A., above the lake and slightly inland, has recorded an increased number of occurrences of temperatures causing winter damage. The Kelowna area experiences much variation in winter minimum temperatures. An analysis of twenty years of winter temperature data revealed that weather stations in the city and hence near to Okanagan Lake, had temperatures moderated accordingly. The twenty year record revealed seven winters when temperatures to -12°C before November 15 or -23°C after mid November, and only one winter when temperatures fell below -26°C. East Kelowna, away from the lake and 130 metres (430 ft) higher in elevation, had twelve winters with temperatures falling to the -12°/-23°C threshold, and seven out of the twenty winters experienced -26°C or lower (Gumbel analysis predicted a -26°C or colder temperature in one winter out of every three to four years).

Okanagan Centre on Okanagan Lake is at the northern limit of the area covered by the Grape Atlas. A temperature of -26°C has a recurrence interval of once in twelve to thirteen years, and a -12°C early winter or -23°C mid winter temperature has been reached in thirteen winters in forty-six years.



Weather Station in Vineyard

Coarse Textured Gravelly Glaciofluvial Deposits

3.1 SOIL DEVELOPMENT

Soil is defined as the upper weathered portion of the earth's crust and serves as a habitat for plants and animals. Soils are a product of the environment and are the result of climate, vegetation, organisms and topography acting on geologic deposits (soil parent material) over time. Due to the interaction of these factors, which can vary with time and from place to place, soils are different from each other. The differences may be small or large and depend upon the magnitude of the factors involved, particularly those of climate and parent material and upon the length of time the factors had been active. Climate directly influences the type of vegetation (organic matter) and the manner in which it is added to the soil. The overall climate of an area determines the microorganism activity, decomposition of organic matter, and the rates of additions to or removal of weathering products from the soils.

The resultant soil differs from the original geologic material from which it was formed in various physical, chemical, mineralogical, biological and morphological properties.

Most soils in this study area have developed under semi-arid climatic conditions in a grassland or dry forest type of environment. The area has low rainfall and high summer temperatures that result in high potential rates of water loss from both soil and plant. This restricts tree growth, limits soil leaching and leads to the accumulation of products from decomposed grasses in the topsoil. These organic matter enriched soils (Chernozems) have formed on a variety of soil parent materials in the Okanagan and Similkameen Valleys.

The grassland soils extend at higher elevations into the dry lower forest zone where the vegetation is composed of Ponderosa pine and Douglas-fir. In these areas the thinner soil surface layer has less organic matter and subsoil colours are generally light brown (Brunisolic soils).

Other soils are characterized by having finer textures and with them translocated clay as a dominant process (Luvisolic soils). Over a long time, clay moves from an upper to a lower soil layer where it eventually may accumulate to such an extent that root and water penetration may be inhibited.

Wet soils (Gleysolic soils) occur throughout the area wherever water is retained in the soil for long periods. They are found on a wide variety of soil parent materials and typically occupy poorly drained to undrained flat or depressional positions in the landscape. Young soils (Regosolic soils) without horizon differentiation are found on some well and rapidly drained portions of floodplains as well as on other steep embankments.

3.2 GLACIATION

The entire area, except some of the highest peaks in the Cascade Range, was covered by ice during at least four separate glaciations. Ice began to accumulate with the onset of each period of glaciation in colder mountainous areas of high precipitation. In these places the accumulated snow was gradually converted into ice. The mountain ranges where early glaciation occurred were the Coast Mountains in the west, the Skeena Mountains in the north and the Monashee Mountains in the east. Later, as glaciation progressed, the ice advanced into valleys and onto the Interior Plateau where the flowing action of glaciers rounded off hills by weight and abrasion. Eventually, a large proportion of British Columbia was covered by a thick ice sheet.

The latest deglaciation commenced about 15,000 years ago with a gradual change to a warmer climate. As the main Okanagan glacier lobe retreated from the toe of the glacier (terminal moraine) in northern Washington State, valley glaciers receded by melting. Ridges and summits then emerged in the highlands due to the lowering of the ice surface. Tributary valley glaciers melted more rapidly than the main Okanagan valley glacier lobe. Some valley and upland areas were free of ice by about 12,000 years ago and were covered with a material orginally eroded from the pre-glacial land surface. This material deposited directly by glacier ice without later modification or sorting by glacial meltwater is known as glacial till.

The main Okanagan Valley glacier, being fed from mountainous areas outside of the Okanagan, was active after much of the highlands had become clear of ice. Ice confined rivers and lakes formed against the Okanagan glacier as large flows of glacial meltwater continued to enter the main valley from the highlands. The glacial meltwaters tended to sort the materials from each other primarily by water velocity. Faster moving water courses deposited coarse sands, gravels, cobbles and stones as crudely bedded glaciofluvial deposits. Slower moving watercourses deposited sands, silts and clays on the former terraces and floodplains. Silts and clays settled out in ice dammed glacial lakes as glaciolacustrine deposits.

Later, when all the glacier ice had melted and the landscape had dried up, wind erosion and re-deposition of sands and silts occurred in sparsely vegetated areas. Extensive areas of wind transported (eolian) materials are found on the wide floodplains and on some glacial tills.

The force of gravity continually affects all materials and plays a dominant role on steeper terrain. All materials that have moved to their present position by direct gravity induced movement are called colluvium. The colluvial materials may either accumulate as shallow or deep deposits on slopes.

Postglacial deposits such as floodplains of rivers and gravelly and sandy fans are deposits of present day streams. Recent fluvial (floodplain) deposits, composed of a variety of water sorted materials, are found along present water courses, while fans have developed where mountain creeks emerge onto level ground. Other deposits of recent times are bogs and swamps. These latter are primarily of organic origin and have generally accumulated in depressions with high water tables.

3.3 SOIL PARENT MATERIALS

3.3.1 Clay and Silt (glaciolacustrine) Sediments

These sediments are widespread throughout the central and northern parts of the study area. They dominantly occur on either side of Skaha and Okanagan Lakes where they are prevalent from Penticton to Naramata, near Westbank, Boucherie Mountain and near Okanagan Mission. These deposits also occur in the Bottom Creek area (locally known as Glenmore Valley), from Rutland to Ellison, and near the lower Similkameen valley.

The sediments are generally composed of stone and gravel-free, moderately and well sorted fine sand, silt and clay. Thin layers of fine sands and silts are common among these deposits south of Peachland and in the lower Similkameen valley while near Westbank, in the Glenmore valley and near Rutland and Ellison the sediments are more commonly mixtures of silt and clay.

Natural subsurface erosion (piping) by ground and irrigation water is common in these sediments along lakeshore bluffs. Frequently the soil surface collapses and results in formation of small steep sided ravines. The individual sinkholes often coalesce and form deeply entrenched gullies.

3.3.2 Meltwater (glaciofluvial) Deposits

These stony, gravelly and/or sandy deposits are widespread and occur throughout the study area on lower valley sides, terraces, and on rolling terrain. Deposition occurred by glacial meltwater streams and resulted in textures that range from well sorted layered gravels and sands to poorly sorted sands, gravels and cobbles. Extensive deposits of sandy veneers over gravels occur at Osoyoos, west of Penticton, higher lying areas west of Summerland, near Peachland, Westbank, large areas in East Kelowna and Rutland as well as in the upland area west of the Kelowna airport.

Deep well sorted sand deposits occur on either side of Osoyoos Lake and north to Oliver, south of McIntyre bluff, near Okanagan Falls to Kaleden and in small pockets from Okanagan Mission to Ellison.

The sands and gravels are porous and permeable and are generally characterized by arid conditions. Ground and irrigation water flow is rapid through these coarse textured deposits mainly because of their typical loose and noncohesive nature.

3.3.3 Unsorted (glacial till) Deposits

Unsorted glacial till deposits, also known as boulder clay, include materials eroded from pre-glacial sediments as well as from rocks that were re-deposited under glacial ice. Glacial till is a non sorted, massive mixture of various shapes, particle sizes and rock types set in a matrix of clay, silt and sand. By comparison with other deposits, unweathered till is relatively compact, highly consolidated, sticks together (cohesive) and is hard when dry. Typically, these deposits are found at higher elevations within the study area where they were least influenced by post glacial meltwater sorting, erosion and deposition.

Soils on till parent materials are found in pockets near Okanagan Falls, at higher elevations above Naramata, Summerland and Westbank, and along the upper benches east and north of Rutland.

The till is usually weathered to a depth of about 1 m and this results in a surface layer of loose non-compact soil. Often a windblown (eolian) capping of sandy or loamy material ranging in thickness from 10 to 30 cm is also present on the surface.

3.3.4 Recent Stream (fluvial) Deposits

These deposits are similar to those of glaciofluvial origin except that erosion and deposition of material has occurred by non-glacial water. The typical deposits are floodplains (alluvium) and stream deposited fans.

3.3.4.1 Recent Floodplain Deposits

Recent floodplains are areas of flat, gently undulating or gently sloping valley bottom land composed of stream deposited gravel, sand or silt. Floodplains are subject to flooding (inundation) during spring run off.

The main floodplain deposits occur on the Similkameen River floodplain from the Ashnola River to the International boundary, on the Okanagan River floodplain between Osoyoos and Okanagan Lakes, and on the Eneas Creek floodplain near Summerland (locally known as Great Valley).

3.3.4.2 Stream Deposited Fans

Fluvial fans are accumulations of gravels and sands with minor amounts of silts and clays. In plan view these deposits are shaped like a fan. They are located along slope breaks where mountain streams enter wide relatively flat valleys. Decrease in slope together with broadening and shallowing of the main stream channel causes soil materials to settle (sediment deposition) and result in the development of small stream channels across the fan. Large fans consist of layered (stratified) and sorted gravels, sands and finer textured materials. The deposits are coarsest at the top (apex) of the fan and become gradually finer towards the fan toe where sands and silts usually occur. The slope of a fan declines from the apex to the toe.

Good examples of stream deposited fans from south to north in the Okanagan valley are those formed by Inkameep, Testalinda, Hestor, Vaseaux, Shuttleworth, Ellis, Shingle, Trout, Penticton, Powers, McDougall, Mission, Sawmill and Scottie creeks.

Many fans that enter the Similkameen River floodplain emerge from steep mountainous terrain and are therefore very bouldery, cobbly and coarse textured at the top.

3.3.5 Windblown (eolian) Deposits

Windblown deposits result from the transport and redeposition of sand and silt by wind action. In the southern Okanagan Valley the eolian process is believed to have started at the close of the glacial period when the exposed material was dry and bare of vegetation. Most windblown deposits occur in the southern Okanagan Valley where they originated from the sandy glaciofluvial deposits.

3.3.6 Organic Deposits

Organic deposits result from accumulation and decay of vegetative matter. Within the study area these deposits occur in and around some depressions with high water tables and in old cut off meander channels (oxbows) on floodplains. Relatively minor areas of organic deposits occur near Oliver, Summerland, Okanagan Mission and near the Kelowna airport.

3.3.7 Colluvial Deposits and Bedrock

Most colluvial materials in the study area have settled by gravity and are of a moderately coarse gravelly texture. The deposits are generally loose, non-compact, porous and permeable. The pore spaces between coarse rock fragments are largely filled with finer materials. Colluvial deposits are generally associated with the bedrock from which they have formed. The deposit depth is usually less than one meter to bedrock except for colluvial fans. Shallow colluvial deposits overlying bedrock are scattered throughout the Okanagan Valley. Major occurrences are located near Kaleden, Summerland, Naramata, Trepanier and west of the Kelowna airport.

3.4 IMPORTANT SOIL PROPERTIES

Soils possess properties that have either been inherited from the parent material or are the result of the soil processes (additions, losses, translocations and transformations) via the soil forming factors. Some of the important soil properties are as follows.

3.4.1 Soil Texture

Soil texture refers to the combination of mineral particle sizes in the soil. A soil can be coarse, medium or fine textured; each is dependent upon the combination of the individual mineral particle sizes which are grouped into four particle sizes as follows:

(1) gravel, size 2 mm to 80 mm, generally rounded and loosely compacted;
(2) sand, size 0.05 mm to 2 mm, subrounded primarily quartz or feldspar minerals;
(3) silt, size 0.002 mm to 0.05 mm, rounded and not sticky when moist or wet; and,
(4) clay, size <0.002 mm, flat secondary minerals, sticky and plastic when wet or moist.

Most soils are mixtures of these four particle sizes and in addition, some also contain organic matter.

Individual soil texture classes are placed into five main soil textural groups. Common properties related to each group are found in Table 19.

Table 19
Main Characteristics of Soil Textural Groups

TEXTURAL GROUP	SOIL TEXTURES	CHARACTERISTICS
Coarse	gravels (G), sand (S), loamy sand (LS)	generally single grained loose and very friable when moist, loose and soft when dry; many large pores; very low water holding capacity; and rapid perviousness; loose sands tend to wind blow; good bearing strength and trafficability when moist
Moderately Coarse	sandy loam (SL)	very friable when moist, moderate to low water holding capacity; good trafficability and bearing strength when moist
Medium	loam (L), silt loam, (SiL), silt (Si)	friable when moist; slightly sticky and plastic when wet; many medium to small pores; high water holding capacity; moderately good trafficability and bearing strength when moist
Moderately Fine	clay loam (CL), silty clay loam (SiCL), sandy clay loam (SCL)	hard to very hard when dry; sticky and plastic when wet; friable to firm when moist; high proportion of small pores; high water holding capacity; poor trafficability when wet
Fine	silty clay (SiC), sandy clay (SC), clay (C) heavy clay (HC)	very hard when dry; very sticky and plastic when wet; firm when moist; many small pores; moderately high water holding capacity; very poor trafficability when wet

In the soil texture triangle, pure sand (S), silt (Si) and clay (C) soils are shown near the triangle corners while soil textures of loam (L) or clay loam (CL) near the centre have various amounts of each.

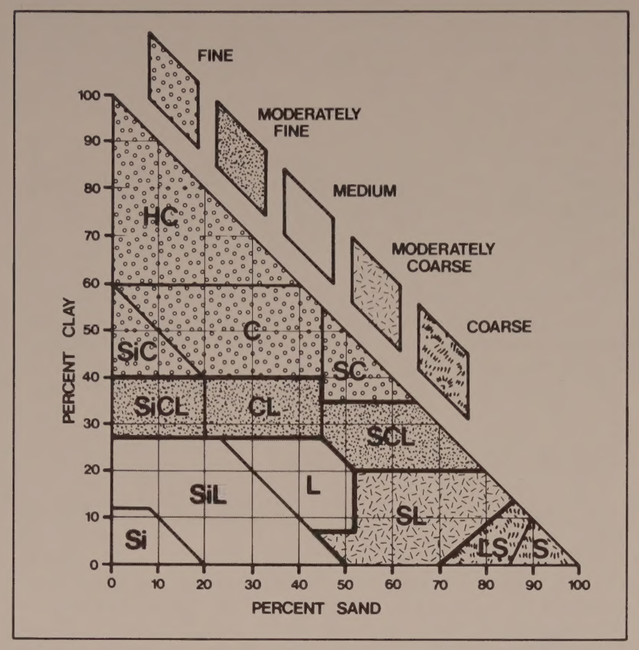


Figure 5 . The Composition of Textural Groups. Percentage of clay and sand in the main textural classes of soils; the remainder of each class in silt

Pure sand, silt or clay textured soils have certain less than desirable properties. In pure sands, for example, large pore spaces are present between individual sand particles. Through these macropore spaces water percolates readily downward so that little is retained for plant growth. Silt and clay soils have small pore spaces that result in a higher water holding capacity. Soils high in clay, however, tend to waterlog, have limited air space and together with other undesirable characteristics may form a less than optimum environment for plant roots.

Loam textured soils are not characterized by any of their three separate components. The gritty properties of sand, the stickiness of clay or the smooth feel of silt do not dominate in loams. Loamy soils are most productive and versatile due to their intermediate textural properties. They have good water holding capacity, a good reservoir of nutrients as well as good aeration and soil thermal properties. Loam textured soils require less specific management in terms of maintaining productivity or workability than either sandy or clayey soils.

3.4.2 Coarse Fragments

Coarse fragments refer to all gravels, cobbles and stones that are larger than 2 mm in diameter. Most soils, excluding silty and clayey glaciolacustrine sediments and organic deposits, contain coarse fragments in various proportions. Typically, meltwater stream terrace deposits as well as some upper stream deposited fans and colluvium contain the most coarse fragments in the soil (% by volume).

3.4.3 Topography (slope) and its Effect on Soil Drainage and Groundwater

Topography and drainage are closely related to soil formation. Topography refers to features of the surface of the land, such as differences in relief or height, direction, steepness, frequency of slopes and the comparative roughness of the surface. The various combinations of these features form the landscape pattern. Typical slope ranges for the particular soil parent materials are found in table 28. Drainage, on the other hand, refers to conditions of water movement both over the surface of the land and within the soil where it is affected by soil texture and type of parent material.

Very coarse textured soils (gravels and sands) take in water readily, but retain only a small amount; any excess water is lost by drainage out of the soil. At the other extreme are fine textured (clayey) soils that take in water slowly but retain a high proportion. Any soil may be rapidly, well, moderately well, imperfectly or poorly drained depending upon water movement away from the soil (e.g. their position in the landscape). For example: internal water movement (drainage) may be slowed down to such an extent on some clay soils that excessive accumulation results in formation of lakes and ponds in depressions. As most air spaces within the soil are taken up by water, there is little oxygen left for respiration by plant roots.

Grape plants are particularly susceptible to restricted drainage conditions. Imperfectly and poorly drained soils usually have finer textures with resulting poor aeration and higher levels of lime and dissolved salts. All these factors lead to insufficient root development and plant growth, poor nutrient uptake, yellowing of vines (chlorosis) and other physiological disorders.

Some imperfectly drained soils with medium textures may be suited for vineyard production if proper rootstocks and adequate surface and subsurface drainage is provided.

Well to rapidly drained soils provide a better rooting medium for most crops especially for grapes than do wet poorly drained soils. Generally, these soils also show conditions of low salinity and lack of groundwater and with adequate aeration they favour good root development.

Excess water is generally rare in well and rapidly drained soils, while in imperfectly, poorly or in very poorly drained soils an excess of soil water is usually present.

Groundwater is either due to seepage, poor soil drainage due to texture (perched water table) or an accumulation in topographic depressions. A fluctuating groundwater table is often present in imperfectly drained soils that may show adequate drainage during the greater part of the year (growing season).

3.4.4 Available Water Storage Capacity (AWSC)

The capacity of a soil to store water depends upon the particle size composition of the soil (texture) and the soil particle arrangement (structure). It is also dependent upon organic matter and content of coarse fragments.

The available water in soils is generally considered as that held between field capacity and the wilting coefficient. Irrigation research indicates that for optimum crop growth, water should be applied when from 50 to 65% of the available water has been consumed (Irrigation Design Manual for Farm Systems in British Columbia, 1983 Revision). The water storage properties of a soil are sometimes inferred from soil texture (Table 20).

Table 20
AWSC Values for Soil Textures in the Okanagan and Similkameen Valleys

TEXTURE CLASS	AWSC* mm/cm of soil	RELATIVE AWSC RATING
gravel	0.2 - 0.6	very low
sand	0.8	very low
loamy sand	1.0	low
sandy loam	1.2	moderate
loam	1.7	moderate
silt loam	2.1	high
clay loam	2.0	high
clay	2.0	high
organic	2.5	very high

*AWSC values are given for the less than 2 mm size fraction only. For gravelly soils with coarse fragments, the AWSC values are correspondingly reduced.

3.4.5 Soil Perviousness

Soil perviousness is a generalized estimate of the potential of a soil to transmit water internally. It is dependent on such soil characteristics as structure, texture, porosity, cracks, organic matter content and shrink-swell properties. Perviousness applies to the whole soil and is closely related to permeability, percolation, and infiltration rates.

The three classes of perviousness are:

1. Rapidly pervious: the capacity to transmit water vertically is so great that the soil will remain wet for no more than a few hours after thoroughly wetting.

2. Moderately pervious: the capacity to transmit water vertically is great enough that the soil will remain saturated for no more than a few days after thorough wetting.

3. Slowly pervious: the potential to transmit water vertically is so slow that the soil will remain saturated for periods of a week or more after thorough wetting.

3.4.6 Soil Temperature

Part of the sun's radiation that reaches the soil is absorbed into the soil surface as heat while the other part is reflected back. Heat transfer from atmosphere to soil is proportionally greater in darker than in lighter coloured soils and explains why darker coloured soils heat up faster than lighter coloured soils. The thermal conductivity and heat capacity are lower for organic than for mineral soils and lower for drier than moister soils. Moist, relatively compacted soils have a high thermal conductivity. They conduct surface heat deep into subsoil layers. In dry, loosely compacted porous soils, however, the thermal conductivity is lower. Their soil surfaces rapidly warm up but as heat transfer to deeper layers is much reduced, a large amount is radiated back to the surrounding air and growing plants.

Topographic conditions also affect the temperature of the soil. This is particularly noticeable when slope orientation (aspect) is considered. Slopes with north and northeast facing aspects are cooler and moister than slopes with south and southwest aspects. In the Okanagan this is shown by a more vigorous tree growth and ground vegetation on northern slopes due mostly to a higher moisture status in the relatively cooler soils. In contrast south and southwest slopes are composed of predominantly darker coloured, warmer grassland soils. The differences in relative soil temperature affect the evapotranspiration, soil microorganism activity and degree of weathering.

Grapevines tend to grow better on relatively porous soils than on fine textured moister and more compacted soils. The warming of moist soils requires a larger amount of energy than for drier soils despite their higher thermal conductivities. In the springtime, moister soils may have characteristically lower temperatures that could retard vine growth. Once these moist soils have reached a higher temperature, their cooling rates are slower and thus they hold the heat for a longer time. Overall moist fine textured soils are relatively cold soils as their warming up is much slower (Table 21).

Table 21
Relative Soil Temperatures Classes

Soil Properties	Relative Soil Temperature Class
well and rapidly drained with moderate amounts of coarse fragments;	warm
well drained medium textured soils;	medium
imperfectly drained groundwater soils (gleyed mineral soils);	cool
poorly drained groundwater soils (gleysols);	cold
organic soils	very cold

The most suitable soils for grape growing are usually dark coloured, south facing and have a medium texture with a moderate proportion of coarse fragments. A vegetation or mulch covered surface is also beneficial as it slows down soil cooling at night during active growth and retards frost penetration in the winter.

The heat energy absorbed by the soil during the daytime often radiates back into the vineyard at night. This heat energy flow favours vine growth development during the spring and also favours ripeness of grapes particularly during frosty nights in the early fall. For this to occur, the soil surface must be moist and more compacted as a dry loose aerated layer has an insulating effect and retards heat flow back into the atmosphere (vineyard).

3.4.7 Soil Water and Soil Aeration

In a productive soil, both air and water must be present in the right proportion. When water is added to the soil by precipitation or irrigation, it first displaces soil air and with it the oxygen in the large pores. Later during drainage this water moves downward and vital oxygen rich air again fills these pores. A soil with its pore spaces full of water for long periods or where groundwater reaches the surface is waterlogged (poorly drained), relatively non aerated, lacks oxygen for plant respiration and other biological activities in the root zone, and is generally unfavourable for normal vine growth. In contrast a soil that contains much air and very little water (such as a sandy or gravelly very coarse textured soil) can also be unfavourable to plant growth (Table 22).

Table 22
Soil Aeration vs Soil Drainage

Soil Properties	Relative Soil Aeration
Rapidly drained soils with large pore spaces and many coarse fragments.	High
Well drained soils with medium textures and moderate amounts of coarse fragments.	Medium
Poorly drained soils with dominant dull colours (gleysols) and very few large pores.	Low

A soil with adequate crop growth potential is well aerated, well drained, has a high available water storage capacity and has medium textures with moderate amounts of coarse fragments.

3.4.8 Restrictions to Root Development

Normal rooting depth for grapes extends to over 1.3 m (4 ft) on deep uniformly porous, friable and fertile soils with the majority of roots located in the upper 50 cm (2 ft) depth. Nutrients in the soil have to be absorbed by the plant roots. It follows that a deep and non-restrictive rooting depth is beneficial for grape plant growth and proper nutrient uptake.

Some of the root restrictions that may occur in soils are: bedrock, watertable, accumulations of salt and lime, compaction of soil, and a textural change to a much finer texture in the subsoil.

3.4.9 Soil Reaction (pH)

Soil pH or reaction denotes conditions of acidity or alkalinity in the solution surrounding the soil particles (Table 23). In an acid reaction (pH <7), acidic (H+) constituents prevail while in an alkaline constituents (OH-) are dominant. When acid and alkaline constituents are in equal concentration the reaction is said to be neutral. Most agricultural crops grow best near neutral pH. Problems in crop growth occur on soils that have either very low or very high pH values (below pH 5 or above 8.5). In the Okanagan and Similkameen study areas, pH values for most soils range from about 6 to 8 in the upper soil while subsoil (deeper than 1 metre) pH values generally range from 7.5 to 8.5. These higher pH values are most commonly found in medium and fine textured calcareous glaciolacustrine subsoils (soil groups 3, 4, 5, 9 in Section 7.5). Strongly alkaline (pH >8.5) conditions tend to reduce availability of most nutrients with other side effects.

Table 23
Ranges of Soil pH

pH Values	Reaction Class Terminology
<4.5	Extremely acid
4.6 - 5.0	Very strongly acid
5.1 - 5.5	Strongly acid
5.6 - 6.0	Medium acid
6.1 - 6.5	Slightly acid
6.6 - 7.3	Neutral
7.4 - 7.8	Mildly alkaline
7.9 - 8.4	Moderately alkaline
>8.5	Strongly alkaline

In regions of low rainfall such as are found in the Okanagan and Similkameen Valleys, calcium and other bases have not been fully leached out of the soil and consequently are present in the subsoils. This generally results in relatively moderate to high levels of calcareousness in subsoils of glaciolacustrine, glacial till, glaciofluvial and colluvial parent materials.

3.4.10 Soil Nutrients and Cation Exchange Capacity

The quantity of elements with a positive charge (cations) that a soil can hold and use in an exchange process is called the Cation Exchange Capacity (CEC). Cation exchange is an important process to soil fertility as the retention of exchangeable cations minimizes nutrient losses due to percolating waters. The exchangeable cations are generally available for plant uptake. As the soil's CEC holds the mineral nutrients required by the growing plant, a high CEC in a soil is a desirable feature. The total CEC is a useful indicator of the relative amount of colloidal material (clay and organic matter) and is usually associated with moisture holding capacity and potential fertility of the soil.

Coarse textured soils such as sands, loamy sands, and gravelly loamy sands have very low CEC as compared with organic matter rich fine textured soils (Table 24).

Table 24
Cation Exchange Capacity and
Class Equivalents

CLASS	CATION EXCHANGE CAPACITY (milli-equiv./100 g)
Very Low	<5
Low	5 - 10
Medium	10 - 20
High	20 - 50
Very High	50 - 150 (only for organic soils)

The cation exchange capacity is based on the fine (<2 mm) fraction (excluding coarse fragments) of the soil.

3.4.11 Soil Salinity

Soil salinity refers to the presence of soluble (easily dissolved) salts in the soil in amounts that may adversely affect plant growth. Most well drained coarse textured soils in the study area are generally free of salts. Weakly to moderately saline conditions are found in subsoils of medium, moderately fine and fine textured glaciolacustrine silty and clayey sediments. In all poorly drained mineral soils as well as on seepage sites, salinity may be light to severe.

Saline conditions are usually expressed in terms of electrical conductivity - a measure of the electrical current flowing through a soil water extract. In the presence of a high concentration of soluble salts, high values for conductivity are obtained. The results of conductivity measurements are usually expressed by numbers representing the conductivity (mS/cm). The salinity classses in Table 25 are only a general guide for saline conditions; critical limits for plant growth may vary with the type of soil and salt, the depth to salts in the soil, the nature of the seasonal rainfall and other factors.

Grapes generally show a low tolerance (sensitive) to saline soils. Depending upon the variety, grape plants usually show saline induced physiological disorders at soil conductivities greater than 3 mS/cm in the upper one metre of soil.

Table 25
Soil Salinity Classes

Salinity Classes	Conductivity (mS/cm)	Plant Growth Conditions
non saline	0	no salinity effects on plant or soil
very weakly saline	0 - 2	salinity effects generally negligible; grape plant growth generally not affected
weakly saline	2 - 4	yields and growth of very sensitive crops such as grapes are somewhat restricted
moderately saline	4 - 8	yields and growth of many plants restricted; not suited for grapes
strongly saline	8 - 16	only salt tolerant crops grow and yield satisfactorily; not suited for grapes

3.5 SOIL GROUPS

For purposes of this atlas, soils in the Okanagan and Similkameen valleys have been grouped into fourteen soil management groups based mainly on parent material, texture, coarse fragments, drainage and topography. Other detailed soil characteristics are presented in Table 26. Each management group is characterized by similar soil limitations for grape production that require similar management input for success.

Table 26
Physical and Chemical Characteristics of Soil Groups

SOIL GROUP	SOIL PARENT MATERIAL	SOIL TEXTURE AND GRAVELLY MODIFYER		COARSE FRAGMENTS (%)		SLOPE (%)	DRAINAGE CLASS	GROUNDWATER	AVAILABLE WATER STORAGE CAPACITY	SOIL PERVIOUSNESS	RELATIVE SOIL TEMPERATURE	RELATIVE SOIL AERATION	RESTRICTIONS TO ROOT DEVELOPMENT	pH (Reaction)		RELATIVE CALCAREOUSNESS		CATION EXCHANGE CAPACITY	SALINITY	
		0-100 cm	>100 cm	0-100 cm	>100 cm									0-100 cm	>100 cm	0-100 cm	>100 cm	0-100 cm	0-100 cm	>100 cm
1	Fluvial fans (surface stoniness: 0%)	medium, gravelly medium	gravelly medium or gravelly mod. coarse	0-40	20-50	1-15	well	absent	moderate to high	moderate	medium	medium	none	6.6-7.8	6.6-7.8	nil	slight to moderate	high	non saline	non or very weakly saline
2	Fluvial fans (surface stoniness: 0-3%)	gravelly mod. coarse	gravelly mod. coarse gravelly coarse	20-75	40-90	5-30	well to rapid	absent	moderate to low	moderate	medium to warm	medium to high	none	6.6-7.8	7.4-8.4	nil to slight	slight to moderate	low	non saline	non or very weakly saline
3	Glacial till	medium	medium, gravelly mod. coarse, gravelly medium	5-20	15-50	10-30	well	absent	moderate	moderate	medium	medium	none	6.6-7.8	7.4-7.8	nil to slight	moderate	medium to low	non saline	very weakly saline
4	Glaciolacustrine	medium, moderately fine, moderately coarse	medium, moderately fine	0-2	0	2-9	well	absent	high	moderate	medium	medium	none to slight (compaction, salinity)	6.1-7.8	7.4-8.4	nil to slight	moderate	medium to low	non or very weakly saline	weakly or moderately saline
5	Glaciofluvial over glaciolacustrine	gravelly coarse gravelly mod. coarse	medium, moderately fine	20-60	0	5-30	well	absent	low to moderate	rapid to moderate	medium to warm	high	none	6.1-7.8	7.4-8.4	nil	moderate	medium to low	non saline	very weakly saline
6	Glaciofluvial, Fluvial fan, Recent fluvial	mod. coarse, coarse mod. coarse, coarse mod. coarse, coarse	coarse, gravelly coarse coarse, gravelly coarse coarse, gravelly coarse	0-10	0-30	2-30	well to rapid	absent	low	rapid	medium to warm	high	none	6.1-7.8	6.6-8.4	nil to slight	nil to slight	low	non saline	non saline
7	Glaciofluvial (stoniness: 3-50%), Fluvial fan (stoniness: 3-50%), Recent fluvial	gravelly mod. coarse gravelly mod. coarse gravelly coarse	gravelly coarse gravelly coarse gravelly coarse	20-60	50-90	2-30	rapid	absent	very low to low	rapid	warm	high	none to slight lime accum. pans	6.1-7.3	7.9-8.4	nil to slight	slight to moderate	low	non saline	non saline
8	Colluvium veneer over bedrock	gravelly mod. coarse	(bedrock)	20-60	-	15-70	rapid	absent	low to moderate	rapid	medium to warm	high	severe (bedrock)	6.6-7.8	7.9-8.4	nil to slight	slight to moderate	medium	non saline	non saline
9	Glaciolacustrine	fine, mod. fine	moderately fine, fine	0	0	2-9	mod. well	absent	moderate to high	slow	medium to cool	low to medium	slight (structure)	6.1-7.8	7.9-8.4	nil to slight	slight to moderate	high	non or very weakly saline	very weakly or weakly saline
10	Fluvial fan, Recent fluvial	mod. coarse, gravelly mod. coarse, medium	gravelly coarse, coarse moderately coarse	10-30 0-10	10-30 0-20	0-5	imperfect	mod. high (50-150 cm)	low to moderate	moderate to rapid	cool to cold	low to medium	slight to mod. (seasonal water table)	6.1-8.4	5.6-8.4	nil to slight		medium to low	non or very weakly saline	very weakly or weakly saline
11	Glaciofluvial, Fluvial fan, Recent fluvial, Glaciolacustrine	gravelly mod. coarse medium, gravelly mod. coarse medium, mod. fine fine, mod. fine	gravelly mod. coarse gravelly mod. coarse medium, gravelly medium mod. fine, medium	0-20	0-50	0-2	poor	high (20-100 cm)	moderate to high	slow	cold to very cold	low	severe (water table salinity lime)	6.6-8.4	6.1-7.8	nil to slight	moderate to high	medium to high	weakly or moderately saline	weakly or moderately saline (variable)
12	Organic	well and semi-well decomposed	semi-well and undecomposed	0	0	0-2	very poor	high (variable)	very high	-	cold to very cold	low	severe (water table)	6.1-7.3	5.6-6.0	slight	nil to slight	very high	very weakly saline	non or very weakly saline
13	non-suitable areas (steep slopes, beach, rock)	variable	variable	variable	variable	0-70	variable	variable	variable	variable	medium	variable	variable	-	-	-	-	-	-	-
14	Major built up areas	variable	variable	variable	variable	0-9	variable	variable	variable	variable	variable	variable	variable	-	-	-	-	-	-	-

Brief characteristics for each soil group are as follows:

Soil Group 1 - consists of well drained soils that developed on medium to moderately fine textured stream deposited fan materials. Subsoil textures are commonly gravelly sandy loam, gravelly silt loam or silt loam. Their cation exchange capacities in the upper soil are high and they occur on less than 15% slopes. The amount of coarse fragments in the upper soil is less than 20%.

Soil Group 2 - consists of well to rapidly drained soils that developed on medium to moderately coarse textured stream deposited fluvial fan materials. The amount of coarse fragments is usually greater than 20%. They occur on 5-30% slopes.

Soil Group 3 - consists of well drained soils developed on medium to moderately coarse textured unsorted till deposits. They occur on slopes ranging from 10 to 30%.

Soil Group 4 - consists of well drained medium textured soils developed on medium to moderately fine textured glaciolacustrine sediments. These soils are weakly to moderately saline at depths deeper than 1 m (3 ft). Slopes range from 2 to 9%.

Soil Group 5 - consists of well drained soils developed on veneers of coarse textured meltwater stream deposits overlying moderately fine textured silty and clayey sediments. These soils are weakly saline at depths deeper than 1 m (3 ft) and occur on slopes ranging from 5 to 30%.

Soil Group 6 - consists of predominantly rapidly drained soils developed on coarse textured meltwater streams, stream deposited fluvial fans or recent stream deposits. Soils of this group are composed of primarily deep sands that have a low available water holding capacity, low cation exchange capacity and occur on slopes ranging up to 30%.

Soil Group 7 - consists of rapidly drained soils developed on coarse textured meltwater streams, stream deposited fans, or recent stream deposits. Soils are largely composed of gravels, sands and cobbles, have very low water holding and cation exchange capacities and occur on slopes ranging up to 30%.

Soil Group 8 - consists of well to rapidly drained soils developed on shallow moderately coarse textured soil veneer (1.2 m or 3 ft) overlying bedrock. The soils contain a high proportion of angular rock fragments and coarse fragments derived from weathered bedrock. These soils have severe limitations mainly due to the shallowness and proximity of bedrock and steep slopes. The soil, however, may contain minor areas deep enough and free of bedrock for viticultural use. Slopes range from 15 to 70%.

Soil Group 9 - consists of moderately well drained soils developed on moderately fine to fine textured silty and clayey glaciolacustrine sediments. The soils are gravel free, have slow infiltration rates, low aeration and a relative cool soil temperature. They occur on slopes ranging from 2 to 9%.

Soil Group 10 - consists of all imperfectly drained soils regardless of parent material. These soils have either developed on stream deposited fans, recent floodplains or on silty and clayey glaciolacustrine sediments. Soil textures range from sandy loam to clay loam. The soil moisture commonly is in excess of field capacity and remains in subsurface soil horizons for moderately long periods during the year. Slopes range from 0 to 5%.

Soil Group 11 - consists of all poorly drained mineral soils regardless of parent material. These soils occur in slight depressions or on flat topography where they have developed on edges of stream deposited fans, recent floodplains or on silty and clayey glaciolacustrine sediments under the influence of relatively high groundwater tables. Slopes range from 0 to 2%. The soil is waterlogged and water remains in all subsurface soil horizons for a large part of the year. These soils are generally in the Gleysolic order.

Soil Group 12 - consists of very poorly drained soils developed on organic materials. These soils have a permanent high water table and are relatively cold. Organic soils occur in gentle depressions in the landscape. Some organic soils are underlain by calcareous marl layers. Slopes range from 0 to 2%.

Soil Group 13 - consists of non suitable sites for grape growth such as very steep topography, recent beach deposits, bedrock, and gravel pits. Steep escarpments with slopes >30% and eroded gullies of silty or clayey glaciolacustrine sediments are also included.

Soil Group 14 - consists of major built up areas. These include the downtown cores of major cities, towns and villages and some subdivisions and industrial sites.

3.6 SOIL SUITABILITY FOR GRAPES

From the above discussion it follows that well suited soils for grape production will possess many of the following properties: a well to rapid soil drainage; medium to moderately coarse textures in their upper horizons; near neutral pH; moderate to high available water storage capacity; good aeration for nonrestricting root development; a desireable structure; moderate soil perviousness; a medium to high cation exchange capacity; relatively warm soil temperatures; absence of high water table and no saline or strongly calcareous conditions within the upper one metre (3 ft) of soil. These qualities are present in soil groups 1, 2, 3, and 4 and are therefore termed well suited with minimal to no limitations (Table 27).

Table 27
Soil Group and Soil Suitability
for Viticulture

CLASS	SOIL GROUP	SOIL SUITABILITY FOR VITICULTURE
1	1, 2, 3, 4	well suited
2	5, 6, 7 ,9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non suited

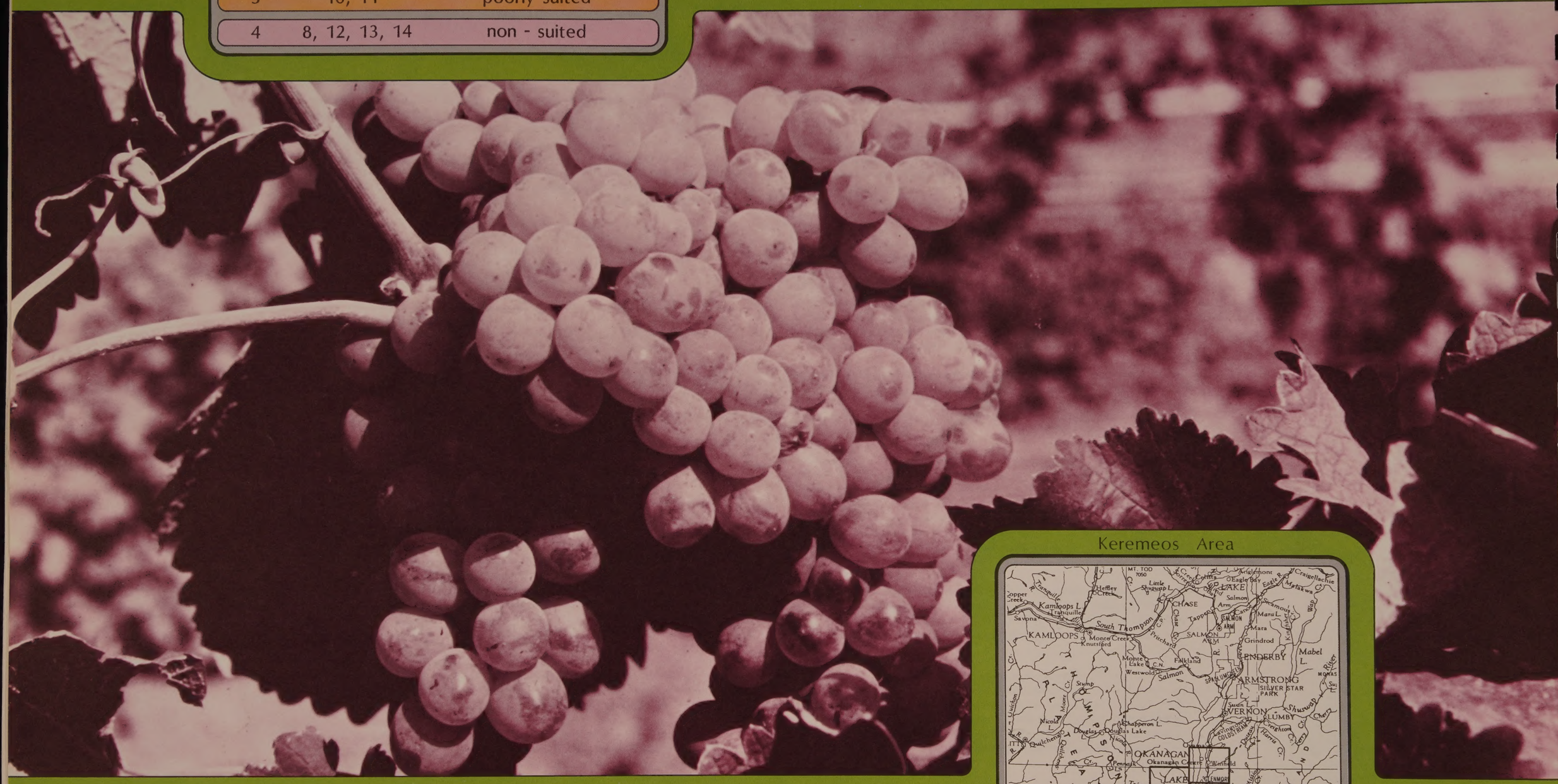
The next group in decending order of suitability is that composed of soil groups 5, 6, 7, and 9. These soils are moderately well suited for grape growing as they possess one or more adverse soil characteristics. The main adverse soil characteristic in soil groups 6 and 7 is the coarse sandy or gravelly sandy texture. Under these conditions, despite the increased aeration and relatively higher soil temperature, additional irrigation water has to be applied. The coarse textures imply lower cation exchange capacity in the soil and relatively low soil fertility. Thus the grower has to rely on more frequent and greater fertilization and careful management. Due to the low water holding capacity, higher aeration and deeper frost penetration (if soils lack a ground cover), the soils make freezing and winter kill of vines more likely. Soil groups 5 and 9 on the other hand have clayey soil textures that dry out slowly, are only moderately well drained and have slow infiltration. The potential root development in the latter is moderately impeded and even though the available water storage capacity is high, the soils are relatively cool.

Poorly suited for grape growing are soil groups 10 and 11. These predominantly wet soils in depressions have soil drainages ranging from imperfect to poor. Some of the dryer soils of group 10 may have some potential if rootstocks resistant to wet soil conditions are used. Most of these wet soils have moderate to high levels of salinity and a variable fertility status. The soils are generally cold and warm up slowly. Unless drainage and increased aeration is feasible, group 11 soils should not be used.

Soil groups 8, 12, 13, and 14 are non suited for grape production for a variety of reasons such as steep slope in excess of 30%; shallow soil veneer and bedrock outcrops, gravel pits, and built up areas.

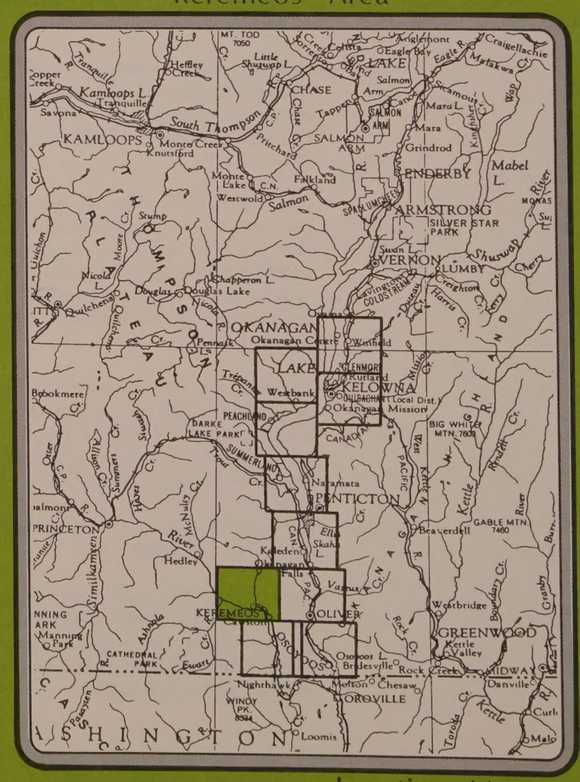
Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

Scale 1:50 000



SOIL GROUPS

Keremeos Area



Location Map

49°20'00"

120°00'00"

KEREMEOS FORKS INDIAN RESERVE 12 A

Keremeos Forks Indian Reserve 12

KEREMEOS COLUMNS PROVINCIAL PARK

ASHNOLA INDIAN RESERVE 10

ASHNOLA

ALEXIS IR 9

Keremeos

Cawston

Twin Lakes

Loak Creek

Cedar Creek

Market Creek

Horn Creek

Bradshaw Creek

Shoemaker Creek

Olalla Creek

Abandoned

Similkameen River

Village Limits

Trailer Park

Fairgrounds

Gas Pipeline

Transformer Station

Water

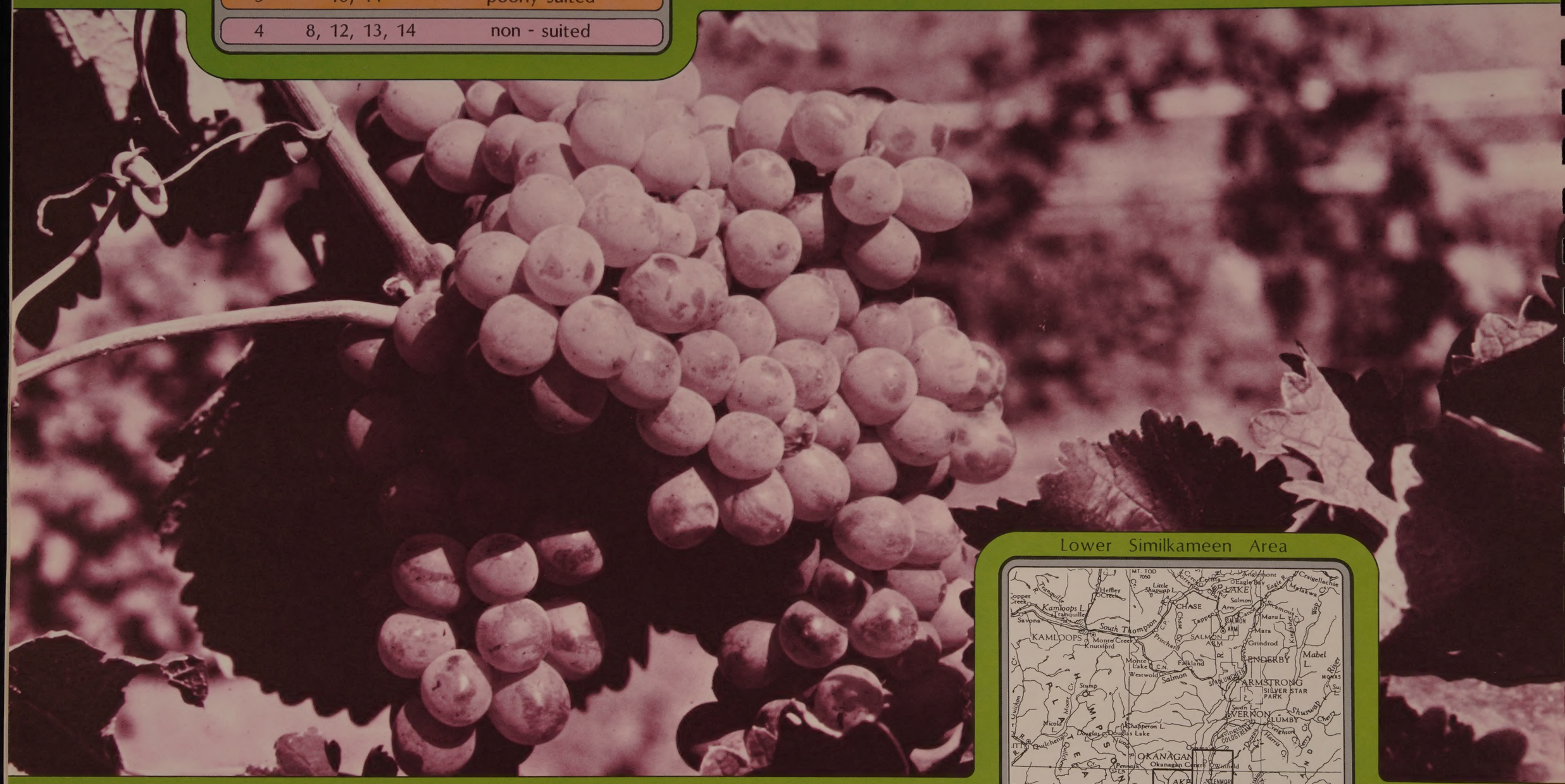
Tp 52

49°10'00"

119°43'00"

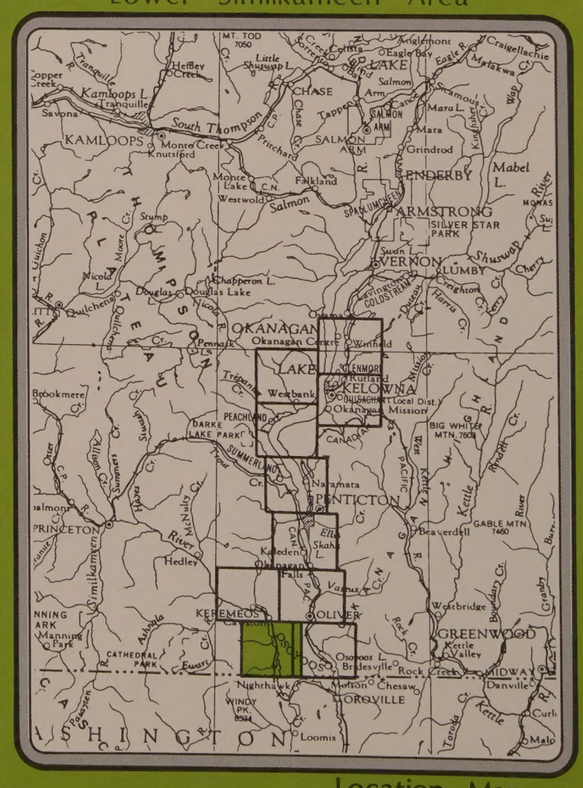
Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

Scale 1:50 000



SOIL GROUPS

Lower Similkameen Area



Location Map

49°10'00"

119°52'00"

ASHNOLA

INDIAN RESERVE 13

PROVINCIAL

FOREST

NARCISSE'S FARM

IR 4

Smilkameen

LOWER SIMILKAMEEN

IR 2

SKEMEOSKUANKIN INDIAN RESERVE 8

SKEMEOSKUANKIN INDIAN RESERVE

OKANAGAN

PROVINCIAL

FOREST

Mount Kobau

Observatory

Television

Golf Course

RICHTER MOUNTAIN

Richter L.

Frank L.

OKANAGAN PROVINCIAL FOREST

CANADA

BRITISH COLUMBIA

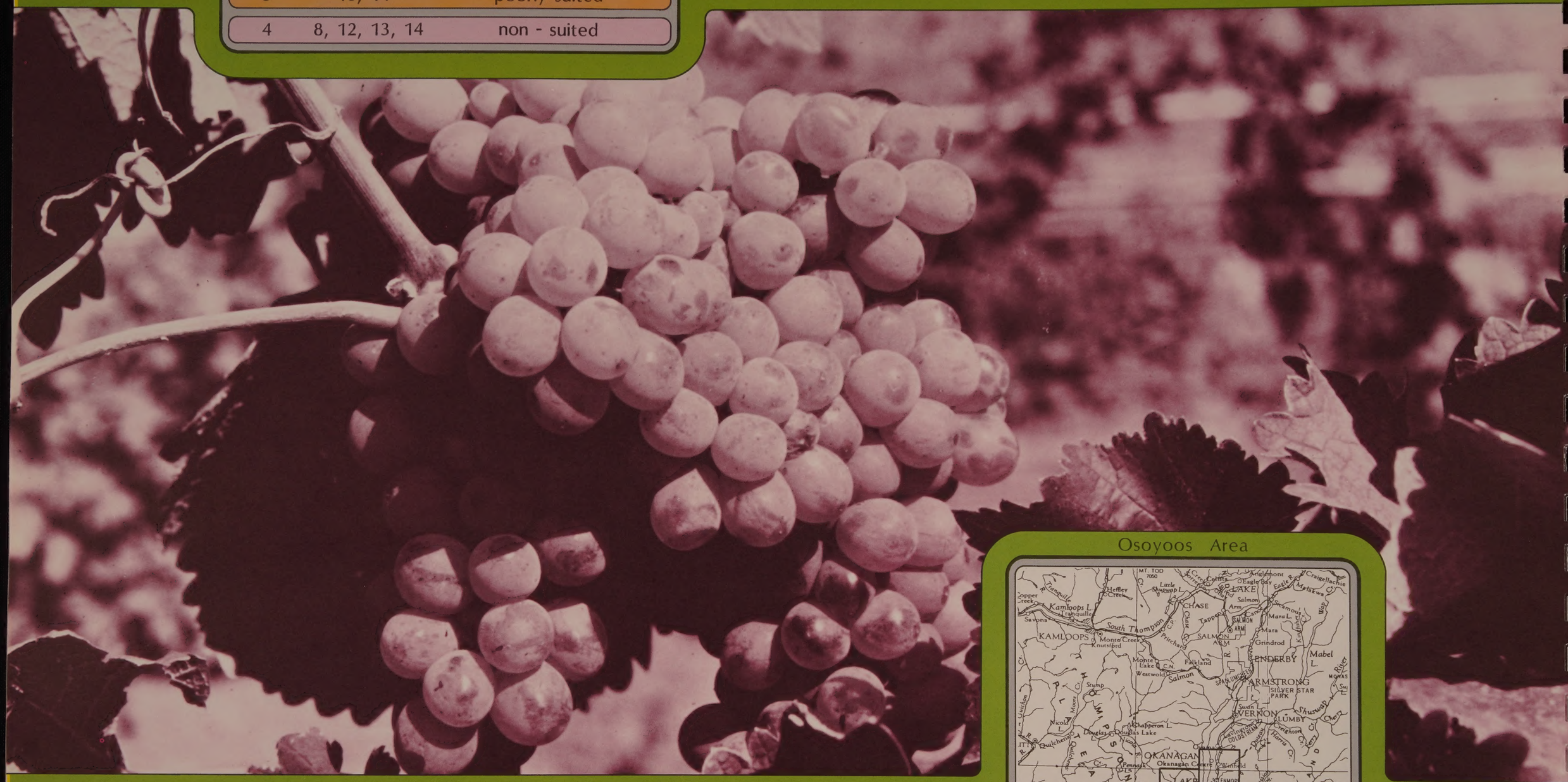
Chopaka Customs

49°00'00"

119°35'00"

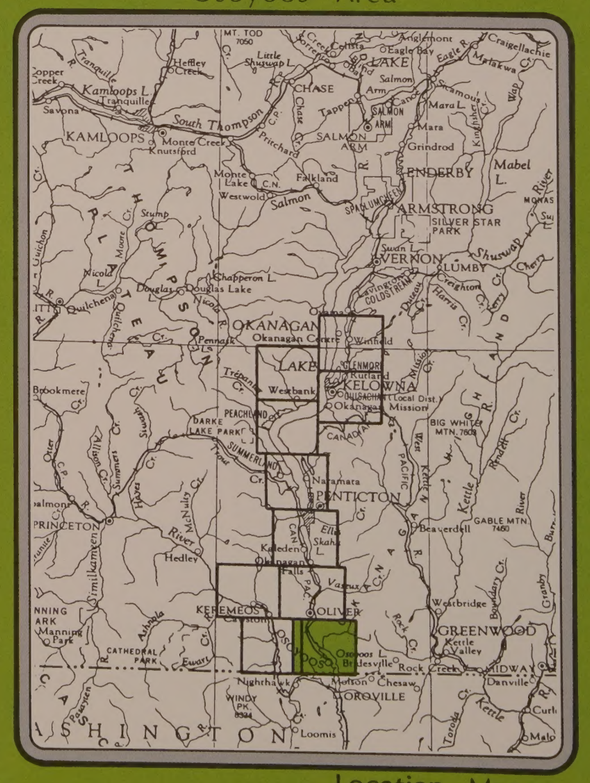
Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

Scale 1:50 000



SOIL GROUPS

Osoyoos Area



Location Map

49°10'00"

119°38'00"

INDIAN RESERVE 1

INDIAN RESERVE 1

OKANAGAN FOREST

OKANAGAN PROVINCIAL FOREST

OKANAGAN MT KRUGER PROVINCIAL FOREST

OSOYOOS LAKE

HAYNES POINT PROV PARK

Osoyoos

Lacey Point

Campsite

Pump House

Boat Ramp

Golf Course

Museum

Community Center

Marina

Auto Wrecker

Sewage

Orchard

Campsites

Anarchist Lookout

Richter Pass

Richter L.

Kilpoola Lake

Inkaneep Creek

Haynes Creek

Long Lake

Hester Creek

Tinhorn Creek

Testalinden Creek

Sinaburkey Ck

Blue Lake Pine Creek

Spotted L.

Comfrd Lake

Mussellshite L.

Tp 51

Tp 49

L 2709

CANADA

119°21'00"

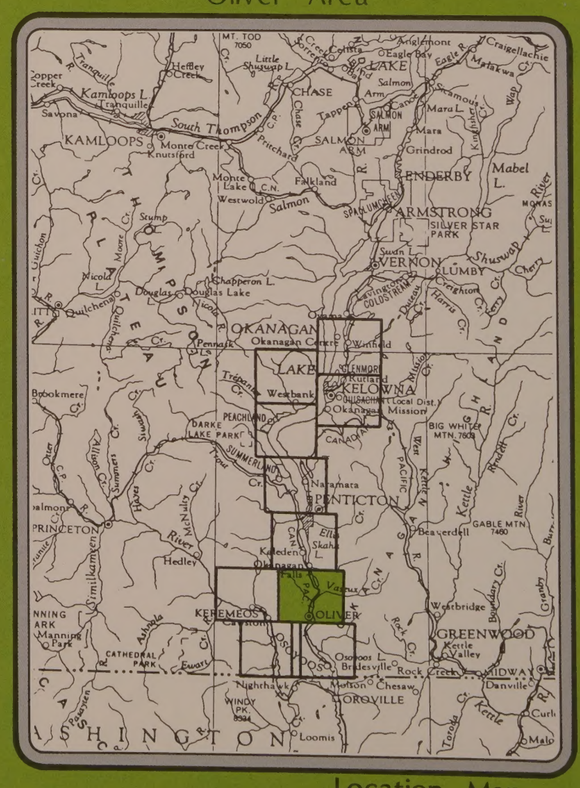
49°00'00"

Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

Scale 1:50 000

SOIL GROUPS

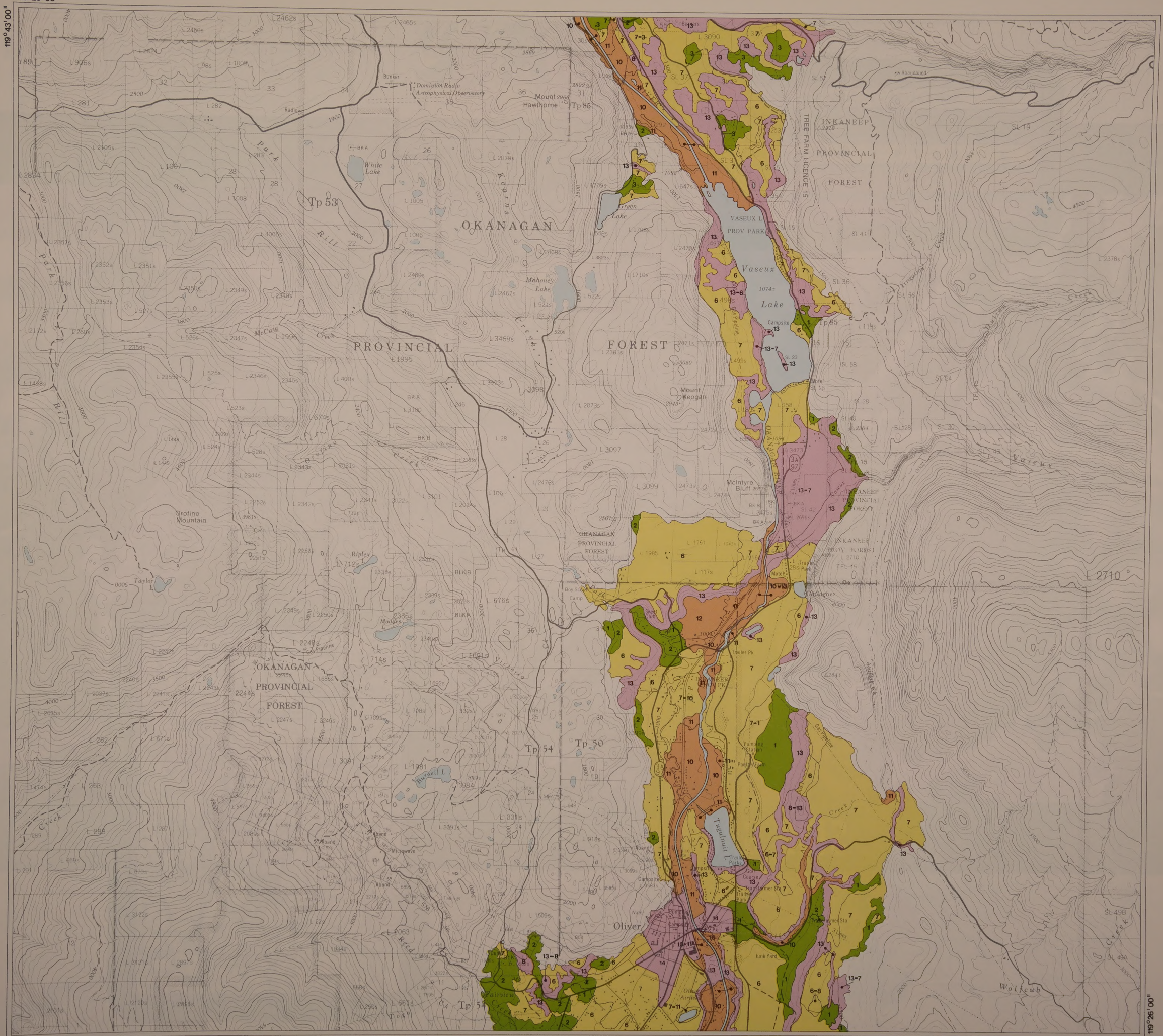
Oliver Area



Location Map

49°20'00"

119°43'00"

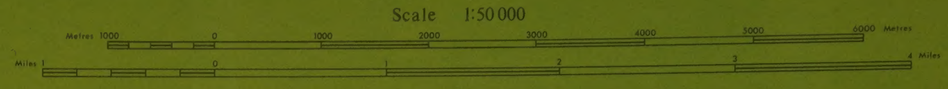


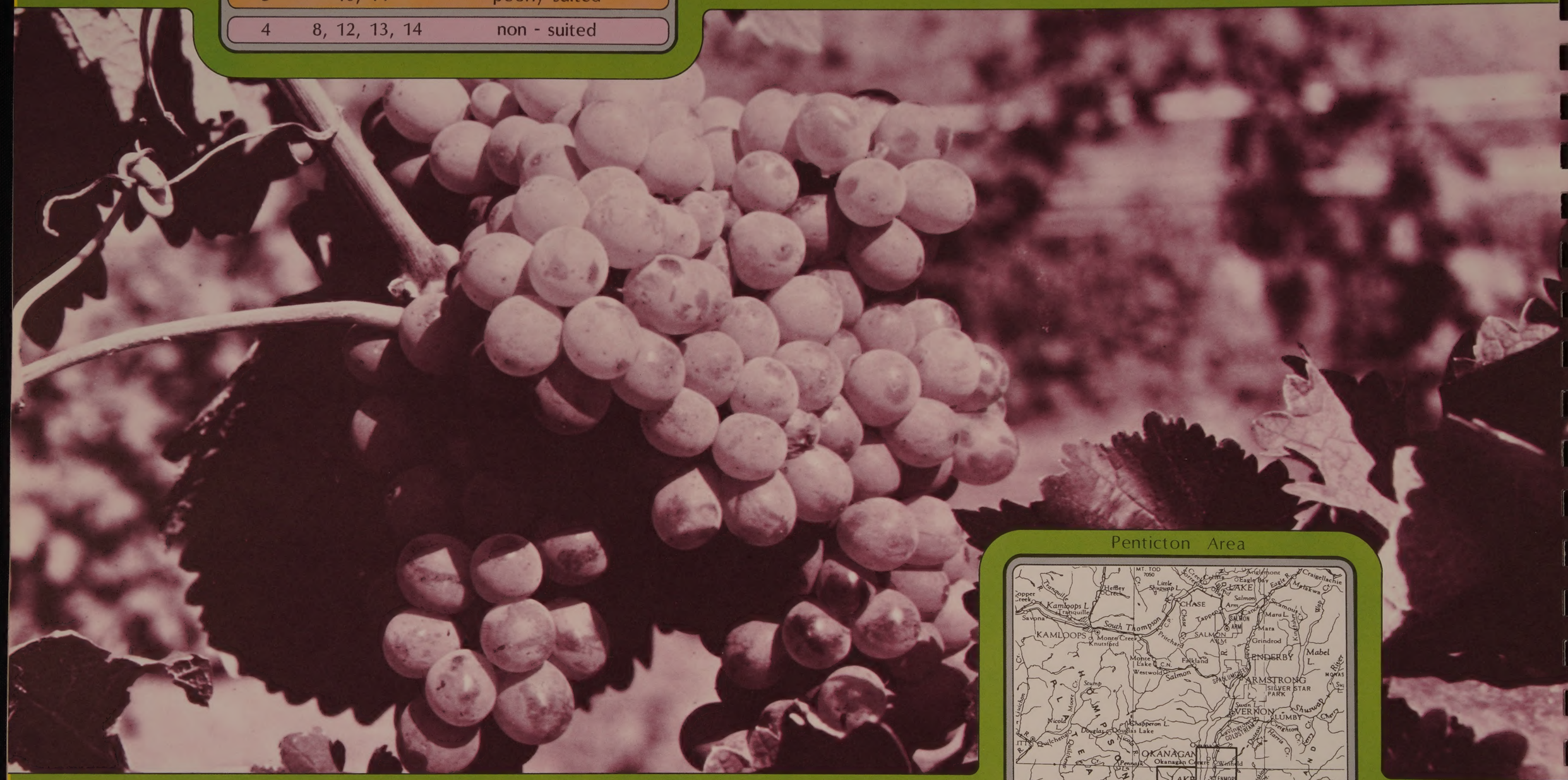
119°26'00"

49°10'00"

Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

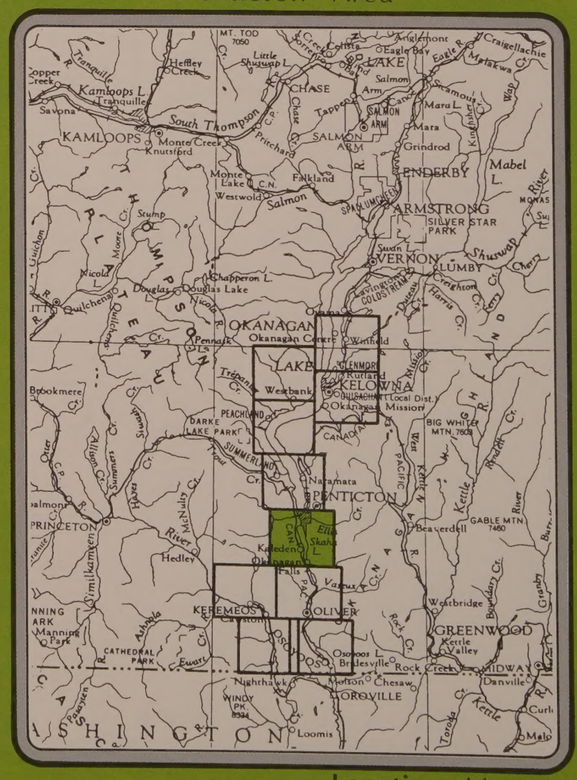
Scale 1:50 000





SOIL GROUPS

Penticton Area



Location Map

49°30'00"

119°45'00"

OKANAGAN PROVINCIAL FOREST

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PENTICTON

INDIAN RESERVE 1

OKANAGAN

L 2710

PROVINCIAL

FOREST

SKAHA

LAKE

Shingle Creek

Fairleigh Lake

Skaha Creek

Penticton Creek

Stewart Creek

Ellis Creek

Gillis Creek

Felis Creek

Derenzy Lake

Derenzy Ck.

Aeneas Lake

Marron River

Marron Lake

Marron Valley

Killey Lake

Trout Lake AKA 353A

Prairie Lake

Mount McLellan

Okanagan Falls

OKANAGAN FALLS PROVINCIAL PARK

Christie Memorial Park

Golf Course

Tp 88

OKANAGAN PROVINCIAL FORRST

Gas Pipeline

Sewage

Pumphouse

Sawmill

Water

Hospital

Cinema

Museum

Radio 1400

Golf Course

Trailer Park

Marina

Park

Bump

Lookout

Gate

Zoo

Trans Sta

Weigh Scale

Derenzy Creek

Thomas Creek

Harkin Creek

McLean Creek

Gillis Creek

Mill Creek

Okanagan Falls

49°20'00"

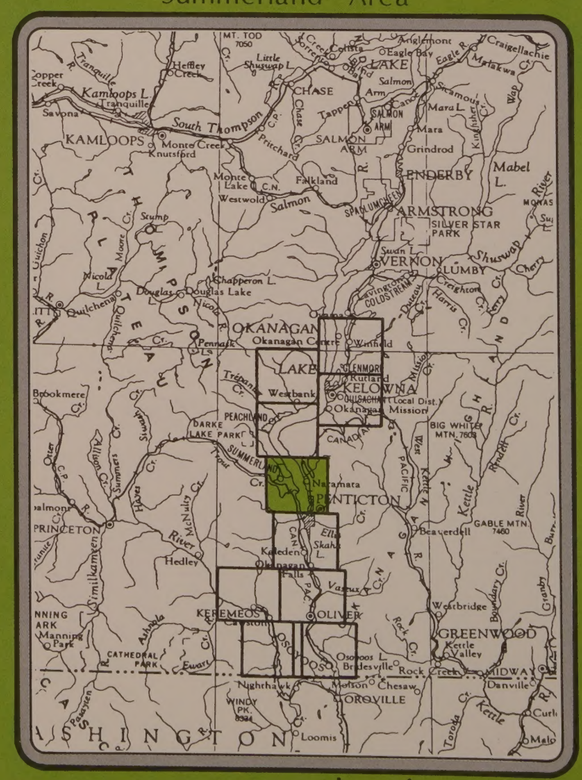
119°28'00"

Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

Scale 1:50 000

SOIL GROUPS

Summerland Area



49°40'00"

119°47'00"

OKANAGAN LAKE

1123±

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT
OSOYOOS DIVISION OF YALE LAND DISTRICT

OKANAGAN PROVINCIAL FOREST

Summerland

West Summerland

Naramata

Adra

Penticton

KICKININEE PROVINCIAL PARK

OKANAGAN MOUNTAIN PROVINCIAL FOREST

INDIAN RESERVE 1

PENTICTON INDIAN RESERVE 3A

MUNSON MOUNTAIN PROV PARK

Mount Campbell

Mount Kobau

Giants Head

Glentir

Faulder

MOUNT CONKLE

BLUE MOUNTAIN

Naramata Lake

Poplar Grove

Trailer Park

Marina

East Penticton

Golf Course

Manitou Provincial Park

Gartrell Point

Television 104

Radio 2760 CKOR

Pumphouse

Breakwater

Arena

Cemetery

Dump

Flume

Gate

Lookout

Creek

Trail

Research Station

Turnball Creek

Brent Lathe

Radio Tower

Mine

Abandoned

Golf Course

Sat Planting

Trailer Park

Marina

Mount Kobau

Mount Campbell

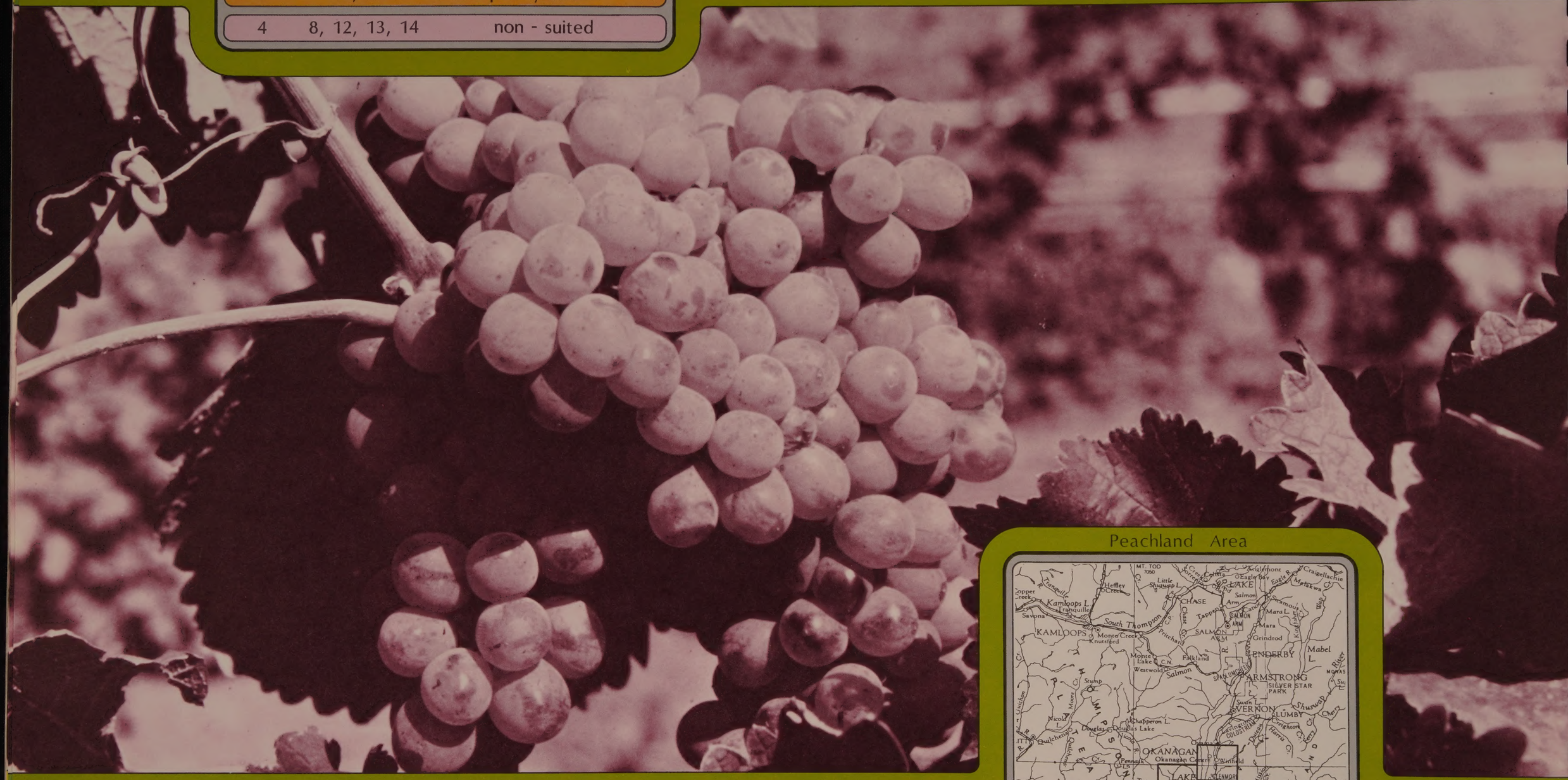
East Penticton

119°30'00"

49°30'00"

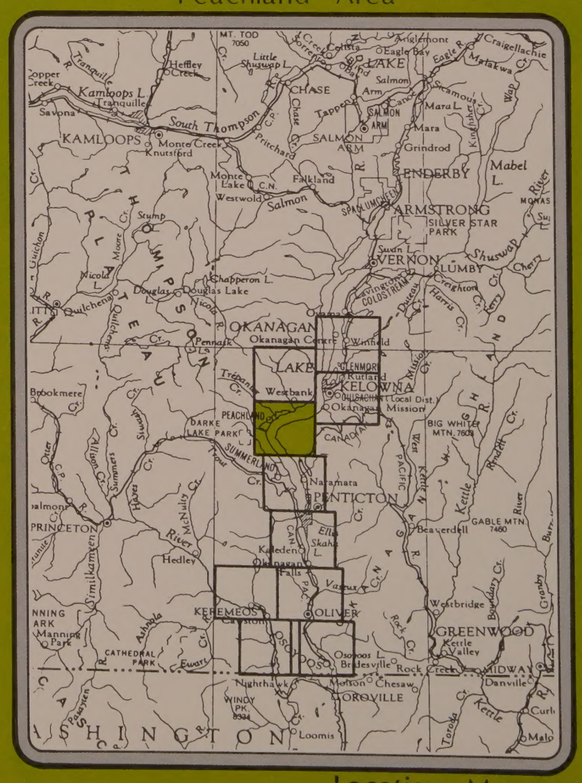
Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

Scale 1:50 000



SOIL GROUPS

Peachland Area



Location Map

49°50'00"

119°49'00"

OKANAGAN LAKE

OSOYOOS DIVISION OF YALE LAND DISTRICT
SIMILKAMEEN DIVISION OF YALE LAND DISTRICT
PEACHLAND DISTRICT MUN.

Mount Law
Mount Drought
Mount Coldham
Spring L.
McCall Lakes
PINCUSHION MTN.
Trepanier
Peachland
Gellatly
Westbank
Rattlesnake Island
Squally Point
Greata
Mount Eneas
Antlers Beach Provincial Park
Trailer Park
Lookout
Marina
Tree Nursery
Reservoir
Pk
Camp
Kelowna City Limits
TP 28
WILD HORSE CANYON
OKANAGAN MOUNTAIN
PROVINCIAL PARK
Norman LO
Ryder Lake
Okanagan Mountain
Meridian
Divide Lake
Gemmell Lake
Chute Lake
Commando Boy
Pipeline
Flume
Pump
Creek
Ck
Valley
L 1380
L 2535
L 2711
L 2734s
L 2738s
1123±
1344
1279
1676
1643
1588
1507
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100

49°40'00"

119°32'00"

Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

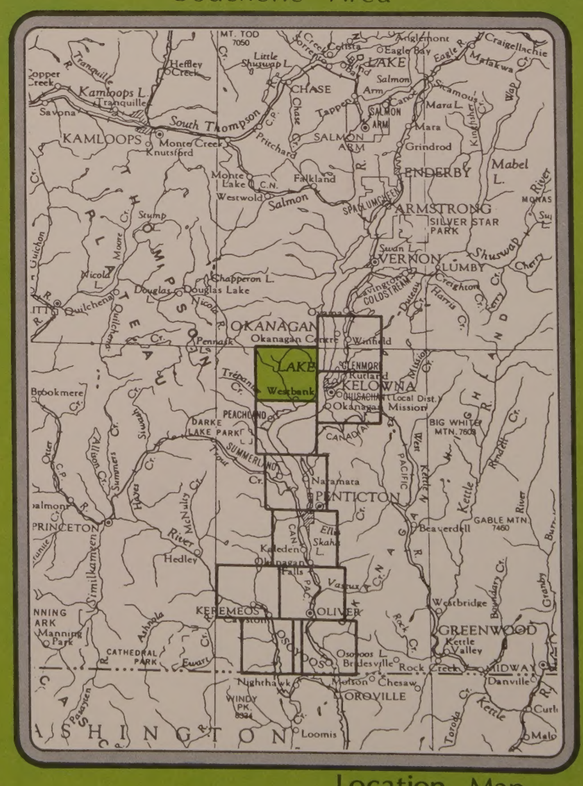
Scale 1:50 000

Metres 1000 0 1000 2000 3000 4000 5000 6000 Metres

Miles 1 0 1 2 3 4 Miles

SOIL GROUPS

Boucherie Area



Location Map

50°00'00"

119°49'00"

WEST OKANAGAN

PROVINCIAL FOREST

PROVINCIAL FOREST

TREE FARM LICENCE 9

TREE FARM LICENCE 9

INDIAN RESERVE 9

TSINSTIKEPTUM 9-11

PARK

Dobbin L.

Inlahi Lake

Bit Creek

Lily L.

Paynter Lake

Banana L.

Jackpine L.

MOUNT CLEMENTS

MOUNT DAST

Mount Miller

Lambly Lake

Lambly Ck

Powers Creek

Carrot Mountain

Mount Swite

Televisions

Ski Lift

Glenrosa

Red Rose Creek

Shield Ck

Lambly Creek

Stronghill Ck

Elliott Creek

Haymac L.

Haymac Creek

McDougall Creek

Rose Valley Lake

Control Gate & Dam

Shannon Lake

Mount Boucherie

Trailer Park

Tree Nursery

Pumphouse

Water

Gate

Dump

Poultry Farm

Underground Reservoir

Hiller Park

Turner Creek

Hunt Creek

Duck Creek

Jack Adams Creek

Ingram Creek

Fuller Creek

Hiller Creek

Fitzsimmons Creek

Fuller Creek

Ellis Creek

Aspen Plains Treatment Plant

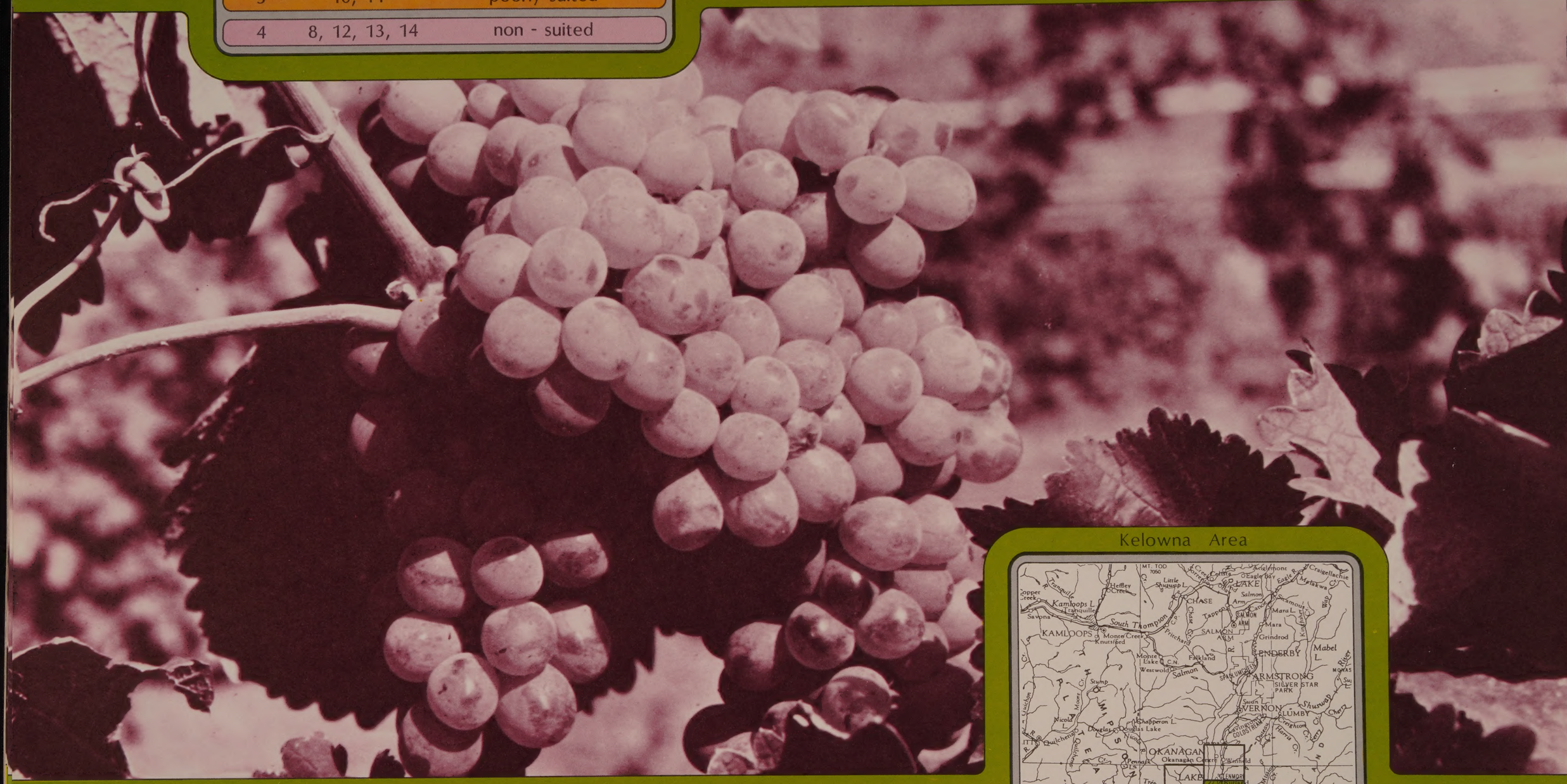
L 3089 L 3087 L 4078 L 4077 L 4075 L 3460 L 1126 L 4180 L 3797 L 3856 L 3858 L 3857 L 4059 L 3903 L 3860 L 1127 L 3456 L 3859 L 3455 L 2178 L 1128 L 4487 L 2177 L 2176 L 3750 L 3861 L 3748 L 3746 L 3745 L 3747 L 3088 L 4076 L 1123 L 1116 L 1121 L 1120 L 1122 L 4771 L 4770 L 3708 L 3249 L 3870 L 3744 L 3707 L 3704 L 3872 L 3191 L 3190 L 3743 L 3709 L 4489 L 4073 L 4072 L 3483 L 3484 L 4495 L 3562 L 3804 L 3978 L 3977 L 3479 L 3485 L 804 L 2554 L 805 L 806 L 2706 L 4333 L 2685 L 3684 L 2600 L 2601 L 2699 L 2044 L 1703 L 3486 L 4227 L 3588 L 4054 L 489 L 4496 L 4497 L 3104 L 2492 L 4662 L 4090 L 3866 L 1479 L 4185 L 2587 L 3748 L 3746 L 3745 L 3747 L 1501 L 1200 L 1934 L 1933 L 1931 L 1930 L 1929 L 1928 L 1927 L 1926 L 1925 L 1924 L 1923 L 1922 L 1921 L 1920 L 1919 L 1918 L 1917 L 1916 L 1915 L 1914 L 1913 L 1912 L 1911 L 1910 L 1909 L 1908 L 1907 L 1906 L 1905 L 1904 L 1903 L 1902 L 1901 L 1900 L 1899 L 1898 L 1897 L 1896 L 1895 L 1894 L 1893 L 1892 L 1891 L 1890 L 1889 L 1888 L 1887 L 1886 L 1885 L 1884 L 1883 L 1882 L 1881 L 1880 L 1879 L 1878 L 1877 L 1876 L 1875 L 1874 L 1873 L 1872 L 1871 L 1870 L 1869 L 1868 L 1867 L 1866 L 1865 L 1864 L 1863 L 1862 L 1861 L 1860 L 1859 L 1858 L 1857 L 1856 L 1855 L 1854 L 1853 L 1852 L 1851 L 1850 L 1849 L 1848 L 1847 L 1846 L 1845 L 1844 L 1843 L 1842 L 1841 L 1840 L 1839 L 1838 L 1837 L 1836 L 1835 L 1834 L 1833 L 1832 L 1831 L 1830 L 1829 L 1828 L 1827 L 1826 L 1825 L 1824 L 1823 L 1822 L 1821 L 1820 L 1819 L 1818 L 1817 L 1816 L 1815 L 1814 L 1813 L 1812 L 1811 L 1810 L 1809 L 1808 L 1807 L 1806 L 1805 L 1804 L 1803 L 1802 L 1801 L 1800 L 1799 L 1798 L 1797 L 1796 L 1795 L 1794 L 1793 L 1792 L 1791 L 1790 L 1789 L 1788 L 1787 L 1786 L 1785 L 1784 L 1783 L 1782 L 1781 L 1780 L 1779 L 1778 L 1777 L 1776 L 1775 L 1774 L 1773 L 1772 L 1771 L 1770 L 1769 L 1768 L 1767 L 1766 L 1765 L 1764 L 1763 L 1762 L 1761 L 1760 L 1759 L 1758 L 1757 L 1756 L 1755 L 1754 L 1753 L 1752 L 1751 L 1750 L 1749 L 1748 L 1747 L 1746 L 1745 L 1744 L 1743 L 1742 L 1741 L 1740 L 1739 L 1738 L 1737 L 1736 L 1735 L 1734 L 1733 L 1732 L 1731 L 1730 L 1729 L 1728 L 1727 L 1726 L 1725 L 1724 L 1723 L 1722 L 1721 L 1720 L 1719 L 1718 L 1717 L 1716 L 1715 L 1714 L 1713 L 1712 L 1711 L 1710 L 1709 L 1708 L 1707 L 1706 L 1705 L 1704 L 1703 L 1702 L 1701 L 1700 L 1699 L 1698 L 1697 L 1696 L 1695 L 1694 L 1693 L 1692 L 1691 L 1690 L 1689 L 1688 L 1687 L 1686 L 1685 L 1684 L 1683 L 1682 L 1681 L 1680 L 1679 L 1678 L 1677 L 1676 L 1675 L 1674 L 1673 L 1672 L 1671 L 1670 L 1669 L 1668 L 1667 L 1666 L 1665 L 1664 L 1663 L 1662 L 1661 L 1660 L 1659 L 1658 L 1657 L 1656 L 1655 L 1654 L 1653 L 1652 L 1651 L 1650 L 1649 L 1648 L 1647 L 1646 L 1645 L 1644 L 1643 L 1642 L 1641 L 1640 L 1639 L 1638 L 1637 L 1636 L 1635 L 1634 L 1633 L 1632 L 1631 L 1630 L 1629 L 1628 L 1627 L 1626 L 1625 L 1624 L 1623 L 1622 L 1621 L 1620 L 1619 L 1618 L 1617 L 1616 L 1615 L 1614 L 1613 L 1612 L 1611 L 1610 L 1609 L 1608 L 1607 L 1606 L 1605 L 1604 L 1603 L 1602 L 1601 L 1600 L 1599 L 1598 L 1597 L 1596 L 1595 L 1594 L 1593 L 1592 L 1591 L 1590 L 1589 L 1588 L 1587 L 1586 L 1585 L 1584 L 1583 L 1582 L 1581 L 1580 L 1579 L 1578 L 1577 L 1576 L 1575 L 1574 L 1573 L 1572 L 1571 L 1570 L 1569 L 1568 L 1567 L 1566 L 1565 L 1564 L 1563 L 1562 L 1561 L 1560 L 1559 L 1558 L 1557 L 1556 L 1555 L 1554 L 1553 L 1552 L 1551 L 1550 L 1549 L 1548 L 1547 L 1546 L 1545 L 1544 L 1543 L 1542 L 1541 L 1540 L 1539 L 1538 L 1537 L 1536 L 1535 L 1534 L 1533 L 1532 L 1531 L 1530 L 1529 L 1528 L 1527 L 1526 L 1525 L 1524 L 1523 L 1522 L 1521 L 1520 L 1519 L 1518 L 1517 L 1516 L 1515 L 1514 L 1513 L 1512 L 1511 L 1510 L 1509 L 1508 L 1507 L 1506 L 1505 L 1504 L 1503 L 1502 L 1501 L 1500 L 1499 L 1498 L 1497 L 1496 L 1495 L 1494 L 1493 L 1492 L 1491 L 1490 L 1489 L 1488 L 1487 L 1486 L 1485 L 1484 L 1483 L 1482 L 1481 L 1480 L 1479 L 1478 L 1477 L 1476 L 1475 L 1474 L 1473 L 1472 L 1471 L 1470 L 1469 L 1468 L 1467 L 1466 L 1465 L 1464 L 1463 L 1462 L 1461 L 1460 L 1459 L 1458 L 1457 L 1456 L 1455 L 1454 L 1453 L 1452 L 1451 L 1450 L 1449 L 1448 L 1447 L 1446 L 1445 L 1444 L 1443 L 1442 L 1441 L 1440 L 1439 L 1438 L 1437 L 1436 L 1435 L 1434 L 1433 L 1432 L 1431 L 1430 L 1429 L 1428 L 1427 L 1426 L 1425 L 1424 L 1423 L 1422 L 1421 L 1420 L 1419 L 1418 L 1417 L 1416 L 1415 L 1414 L 1413 L 1412 L 1411 L 1410 L 1409 L 1408 L 1407 L 1406 L 1405 L 1404 L 1403 L 1402 L 1401 L 1400 L 1399 L 1398 L 1397 L 1396 L 1395 L 1394 L 1393 L 1392 L 1391 L 1390 L 1389 L 1388 L 1387 L 1386 L 1385 L 1384 L 1383 L 1382 L 1381 L 1380 L 1379 L 1378 L 1377 L 1376 L 1375 L 1374 L 1373 L 1372 L 1371 L 1370 L 1369 L 1368 L 1367 L 1366 L 1365 L 1364 L 1363 L 1362 L 1361 L 1360 L 1359 L 1358 L 1357 L 1356 L 1355 L 1354 L 1353 L 1352 L 1351 L 1350 L 1349 L 1348 L 1347 L 1346 L 1345 L 1344 L 1343 L 1342 L 1341 L 1340 L 1339 L 1338 L 1337 L 1336 L 1335 L 1334 L 1333 L 1332 L 1331 L 1330 L 1329 L 1328 L 1327 L 1326 L 1325 L 1324 L 1323 L 1322 L 1321 L 1320 L 1319 L 1318 L 1317 L 1316 L 1315 L 1314 L 1313 L 1312 L 1311 L 1310 L 1309 L 1308 L 1307 L 1306 L 1305 L 1304 L 1303 L 1302 L 1301 L 1300 L 1299 L 1298 L 1297 L 1296 L 1295 L 1294 L 1293 L 1292 L 1291 L 1290 L 1289 L 1288 L 1287 L 1286 L 1285 L 1284 L 1283 L 1282 L 1281 L 1280 L 1279 L 1278 L 1277 L 1276 L 1275 L 1274 L 1273 L 1272 L 1271 L 1270 L 1269 L 1268 L 1267 L 1266 L 1265 L 1264 L 1263 L 1262 L 1261 L 1260 L 1259 L 1258 L 1257 L 1256 L 1255 L 1254 L 1253 L 1252 L 1251 L 1250 L 1249 L 1248 L 1247 L 1246 L 1245 L 1244 L 1243 L 1242 L 1241 L 1240 L 1239 L 1238 L 1237 L 1236 L 1235 L 1234 L 1233 L 1232 L 1231 L 1230 L 1229 L 1228 L 1227 L 1226 L 1225 L 1224 L 1223 L 1222 L 1221 L 1220 L 1219 L 1218 L 1217 L 1216 L 1215 L 1214 L 1213 L 1212 L 1211 L 1210 L 1209 L 1208 L 1207 L 1206 L 1205 L 1204 L 1203 L 1202 L 1201 L 1200 L 1199 L 1198 L 1197 L 1196 L 1195 L 1194 L 1193 L 1192 L 1191 L 1190 L 1189 L 1188 L 1187 L 1186 L 1185 L 1184 L 1183 L 1182 L 1181 L 1180 L 1179 L 1178 L 1177 L 1176 L 1175 L 1174 L 1173 L 1172 L 1171 L 1170 L 1169 L 1168 L 1167 L 1166 L 1165 L 1164 L 1163 L 1162 L 1161 L 1160 L 1159 L 1158 L 1157 L 1156 L 1155 L 1154 L 1153 L 1152 L 1151 L 1150 L 1149 L 1148 L 1147 L 1146 L 1145 L 1144 L 1143 L 1142 L 1141 L 1140 L 1139 L 1138 L 1137 L 1136 L 1135 L 1134 L 1133 L 1132 L 1131 L 1130 L 1129 L 1128 L 1127 L 1126 L 1125 L 1124 L 1123 L 1122 L 1121 L 1120 L 1119 L 1118 L 1117 L 1116 L 1115 L 1114 L 1113 L 1112 L 1111 L 1110 L 1109 L 1108 L 1107 L 1106 L 1105 L 1104 L 1103 L 1102 L 1101 L 1100 L 1099 L 1098 L 1097 L 1096 L 1095 L 1094 L 1093 L 1092 L 1091 L 1090 L 1089 L 1088 L 1087 L 1086 L 1085 L 1084 L 1083 L 1082 L 1081 L 1080 L 1079 L 1078 L 1077 L 1076 L 1075 L 1074 L 1073 L 1072 L 1071 L 1070 L 1069 L 1068 L 1067 L 1066 L 1065 L 1064 L 1063 L 1062 L 1061 L 1060 L 1059 L 1058 L 1057 L 1056 L 1055 L 1054 L 1053 L 1052 L 1051 L 1050 L 1049 L 1048 L 1047 L 1046 L 1045 L 1044 L 1043 L 1042 L 1041 L 1040 L 1039 L 1038 L 1037 L 1036 L 1035 L 1034 L 1033 L 1032 L 1031 L 1030 L 1029 L 1028 L 1027 L 1026 L 1025 L 1024 L 1023 L 1022 L 1021 L 1020 L 1019 L 1018 L 1017 L 1016 L 1015 L 1014 L 1013 L 1012 L 1011 L 1010 L 1009 L 1008 L 1007 L 1006 L 1005 L 1004 L 1003 L 1002 L 1001 L 1000 L 999 L 998 L 997 L 996 L 995 L 994 L 993 L 992 L 991 L 990 L 989 L 988 L 987 L 986 L 985 L 984 L 983 L 982 L 981 L 980 L 979 L 978 L 977 L 976 L 975 L 974 L 973 L 972 L 971 L 970 L 969 L 968 L 967 L 966 L 965 L 964 L 963 L 962 L 961 L 960 L 959 L 958 L 957 L 956 L 955 L 954 L 953 L 952 L 951 L 950 L 949 L 948 L 947 L 946 L 945 L 944 L 943 L 942 L 941 L 940 L 939 L 938 L 937 L 936 L 935 L 934 L 933 L 932 L 931 L 930 L 929 L 928 L 927 L 926 L 925 L 924 L 923 L 922 L 921 L 920 L 919 L 918 L 917 L 916 L 915 L 914 L 913 L 912 L 911 L 910 L 909 L 908 L 907 L 906 L 905 L 904 L 903 L 902 L 901 L 900 L 899 L 898 L 897 L 896 L 895 L 894 L 893 L 892 L 891 L 890 L 889 L 888 L 887 L 886 L 885 L 884 L 883 L 882 L 881 L 880 L 879 L 878 L 877 L 876 L 875 L 874 L 873 L 872 L 871 L 870 L 869 L 868 L 867 L 866 L 865 L 864 L 863 L 862 L 861 L 860 L 859 L 858 L 857 L 856 L 855 L 854 L 853 L 852 L 851 L 850 L 849 L 848 L 847 L 846 L 845 L 844 L 843 L 842 L 841 L 840 L 839 L 838 L 837 L 836 L 835 L 834 L 833 L 832 L 831 L 830 L 829 L 828 L 827 L 826 L 825 L 824 L 823 L 822 L 821 L 820 L 819 L 818 L 817 L 816 L 815 L 814 L 813 L 812 L 811 L 810 L 809 L 808 L 807 L 806 L 805 L 804 L 803 L 802 L 801 L 800 L 799 L 798 L 797 L 796 L 795 L 794 L 793 L 792 L 791 L 790 L 789 L 788 L 787 L 786 L 785 L 784 L 783 L 782 L 781 L 780 L 779 L 778 L 777 L 776 L 775 L 774 L 773 L 772 L 771 L 770 L 769 L 768 L 767 L 766 L 765 L 764 L 763 L 762 L 761 L 760 L 759 L 758 L 757 L 756 L 755 L 754 L 753 L 752 L 751 L 750 L 749 L 748 L 747 L 746 L 745 L 744 L 743 L 742 L 741 L 740 L 739 L 738 L 737 L 736 L 735 L 734 L 733 L 732 L 731 L 730 L 729 L 728 L 727 L 726 L 725 L 724 L 723 L 722 L 721 L 720 L 719 L 718 L 717 L 716 L 715 L 714 L 713 L 712 L 711 L 710 L 709 L 708 L 707 L 706 L 705 L 704 L 703 L 702 L 701 L 700 L 699 L 698 L 697 L 696 L 695 L 694 L 693 L 692 L 691 L 690 L 689 L 688 L 687 L 686 L 685 L 684 L 683 L 682 L 681 L 680 L 679 L 678 L 677 L 676 L 675 L 674 L 673 L 672 L 671 L 670 L 669 L 668 L 667 L 666 L 665 L 664 L 663 L 662 L 661 L 660 L 659 L 658 L 657 L 656 L 655 L 654 L 653 L 652 L 651 L 650 L 649 L 648 L 647 L 646 L 645 L 644 L 643 L 642 L 641 L 640 L 639 L 638 L 637 L 636 L 635 L 634 L 633 L 632 L 631 L 630 L 629 L 628 L 627 L 626 L 625 L 624 L 623 L 622 L 621 L 620 L 619 L 618 L 617 L 616 L 615 L 614 L 613 L 612 L 611 L 610 L 609 L 608 L 607 L 606 L 605 L 604 L 603 L 602 L 601 L 600 L 599 L 598 L 597 L 596 L 595 L 594 L 593 L 592 L 591 L 590 L 589 L 588 L 587 L 586 L 585 L 584 L 583 L 582 L 581 L 580 L 579 L 578 L 577 L 576 L 575 L 574 L 573 L 572 L 571 L 570 L 569 L 568 L 567 L 566 L 565 L 564 L 563 L 562 L 561 L 560 L 559 L 558 L 557 L 556 L 555 L 554 L 553 L 552 L 551 L 550 L 549 L 548 L 547 L 546 L 545 L 544 L 543 L 542 L 541 L 540 L 539 L 538 L 537 L 536 L 535 L 534 L 533 L 532 L 531 L 530 L 529 L 528 L 527 L 526 L 525 L 524 L 523 L 522 L 521 L 520 L 519 L 518 L 517 L 516 L 515 L 514 L 513 L 512 L 511 L 510 L 509 L 508 L 507 L 506 L 505 L 504 L 503 L 502 L 501 L 500 L 499 L 498 L 497 L 496 L 495 L 494 L 493 L 492 L 491 L 490 L 489 L 488 L 487 L 486 L 485 L 484 L 483 L 482 L 481 L 480 L 479 L 478 L 477 L 476 L 475 L 474 L 473 L 472 L 471 L 470 L 469 L 468 L 467 L 466 L 465 L 464 L 463 L 462 L 461 L 460 L 459 L 458 L 457 L 456 L 455 L 454 L 453 L 452 L 451 L 450 L 449 L 448 L 447 L 446 L 445 L 444 L 443 L 442 L 441 L 440 L 439 L 438 L 437 L 436 L 435 L 434 L 433 L 432 L 431 L 430 L 429 L 428 L 427 L 426 L 425 L 424 L 423 L 422 L 421 L 420 L 419 L 418 L 417 L 416 L 415 L 414 L 413 L 412 L 411 L 410 L 409 L 408 L 407 L 406 L 405 L 404 L 403 L 402 L 401 L 400 L 399 L 398 L 397 L 396 L 395 L 394 L 393 L 392 L 391 L 390 L 389 L 388 L 387 L 386 L 385 L 384 L 383 L 382 L 381 L 380 L 379 L 378 L 377 L 376 L 375 L 374 L 373 L 372 L 371 L 370 L 369 L 368 L 367 L 366 L 365 L 364 L 363 L 362 L 361 L 360 L 359 L 358 L 357 L 356 L 355 L 354 L 353 L 352 L 351 L 350 L 349 L 348 L 347 L 346 L 345 L 344 L 343 L 342 L 341 L 340 L 339 L 338 L 337 L 336 L 335 L 334 L 333 L 332 L 331 L 330 L 329 L 328 L 327 L 326 L 325 L 324 L 323 L 322 L 321 L 320 L 319 L 318 L 317 L 316 L 315 L 314 L 313 L 312 L 311 L 310 L 309 L 308 L 307 L 306 L 305 L 304 L 303 L 302 L 301 L 300 L 299 L 298 L 297 L 296 L 295 L 294 L 293 L 292 L 291 L 290 L 289 L 288 L 287 L 286 L 285 L 284 L 283 L 282 L 281 L 280 L 279 L 278 L 277 L 276 L 275 L 274 L 273 L 272 L 271 L 270 L 269 L 268 L 267 L 266 L 265 L 264 L 263 L 262 L 261 L 260 L 259 L 258 L 257 L 256 L 255 L 254 L 253 L 252 L 251 L 250 L 249 L 248 L 247 L 246 L 245 L 244 L 243 L 242 L 241 L 240 L 239 L 238 L 237 L 236 L 235 L 234 L 233 L 232 L 231 L 230 L 229 L 228 L 227 L 226 L 225 L 224 L 223 L 222 L 221 L 220 L 219 L 218 L 217 L 216 L 215 L 214 L 213 L 212 L 211 L 210 L 209 L 208 L 207 L 206 L 205 L 204 L 203 L 202 L 201 L 200 L 199 L 198 L 197 L 196 L 195 L 194 L 193 L 192 L 191 L 190 L 189 L 188 L 187 L 186 L 185 L 184 L 183 L 182 L 181 L 180 L 179 L 178 L 177 L 176 L 175 L 174 L 173 L 172 L 171 L 170 L 169 L 168 L 167 L 166 L 165 L 164 L 163 L 162 L 161 L 160 L 159 L 158 L 157 L 156 L 155 L 154 L 153 L 152 L 151 L 150 L 149 L 148 L 147 L 146 L 145 L 144 L 143 L 142 L 141 L 140 L 139 L 138 L 137 L 136 L 135 L 134 L 133 L 132 L 131 L 130 L 129 L 128 L 127 L 126 L 125 L 124 L 123 L 122 L 121 L 120 L 119 L 118 L 117 L 116 L 115 L 114 L 113 L 112 L 111 L 110 L 109 L 108 L 107 L 106 L 105 L 104 L 103 L 102 L 101 L 100 L 99 L 98 L 97 L 96 L 95 L 94 L 93 L 92 L 91 L 90 L 89 L 88 L 87 L 86 L 85 L 84 L 83 L 82 L 81 L 80 L 79 L 78 L 77 L 76 L 75 L 74 L 73 L 72 L 71 L 70 L 69 L 68 L 67 L 66 L 65 L 64 L 63 L 62 L 61 L 60 L 59 L 58 L 57 L 56 L 55 L 54 L 53 L 52 L 51 L 50 L 49 L 48 L 47 L 46 L 45 L 44 L 43 L 42 L 41 L 40 L 39 L 38 L 37 L 36 L 35 L 34 L 33 L 32 L 31 L 30 L 29 L 28 L 27 L 26 L 25 L 24 L 23 L 22 L 21 L 20 L 19 L 18 L 17 L 16 L 15 L 14 L 13 L 12 L 11 L 10 L 9 L 8 L 7 L 6 L 5 L 4 L 3 L 2 L 1

49°50'00"

119°32'00"

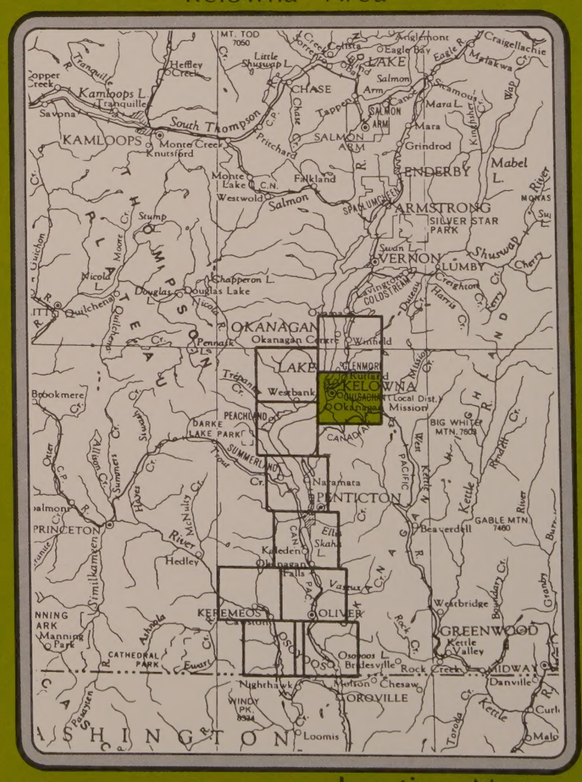
Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

Scale 1:50 000



SOIL GROUPS

Kelowna Area



Location Map

49°56'00"

119°32'00"

KELOWNA

Westside

Manhattan Point

Okanagan Mission

East Kelowna

Rutland

Mount Knox

Mount Dilworth

Black Knight Mountain

Knox Mountain Park

Sutherland Hills Prov Park

Okanagan College

Mission Creek Park

Jack Smith Lake

Aspbalt Plant

Golf Course

Shopping Centre

Hospital

Marina

Lookout

Lift

Reservoir

Pumphouse

Water Pipeline

Flume

Trailer Park

Cemetery

Radio

Fire

Tp 25

Tp 27

Tp 28

Tp 29

Okanagan

Mission Creek

Bulman Creek

Belgo Creek

Powder Creek

Ellis Creek

Bellevue Creek

Hydraulic Creek

Mill Creek

Fascieux Creek

Fraser

Water

Gas Pipeline

CANADIAN PACIFIC RAILWAY

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

OSOYOOS DIVISION OF YALE LAND DISTRICT

119°15'00"

49°46'00"

Class	Soil Group	Suitability for Viticulture
1	1, 2, 3, 4	well suited
2	5, 6, 7, 9	moderately well suited
3	10, 11	poorly suited
4	8, 12, 13, 14	non - suited

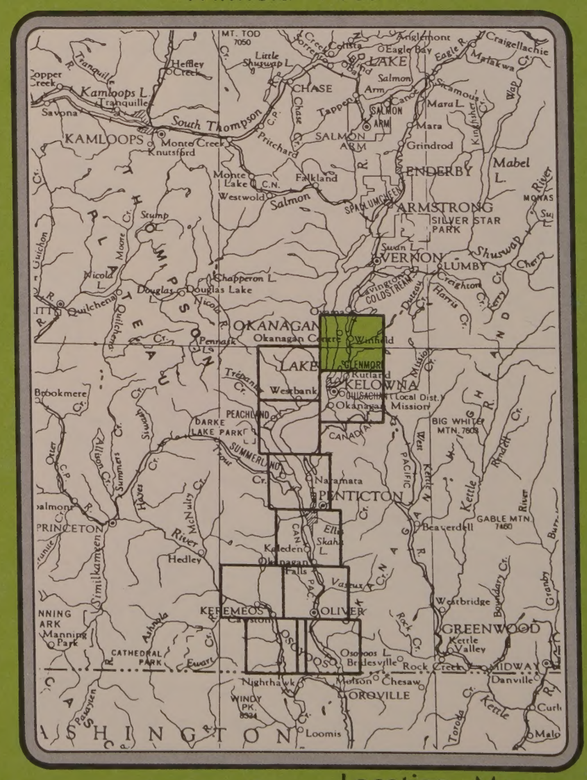
Scale 1:50 000

Metres 1000 0 1000 2000 3000 4000 5000 6000 Metres

Miles 1 0 1 2 3 4 Miles

SOIL GROUPS

Winfield Area



Location Map

50°06'00"

119°32'00"

119°15'00"

49°56'00"

WOOD LAKE

OKANAGAN LAKE

Nahun

Caesars

OKANAGAN PROVINCIAL FOREST

Okanagan Centre

Tp 20

Tp 21

Tp 23

Tp 24

Winfield

Oyama

Vernon

Kelowna

Ellison

Lake

Wilson Landing

Traders Cove

Horseshoe Gulch

Girl Guide Camp

TFL 9

TREE FARM LICENCE 6

WEST OKANAGAN PROVINCIAL FOREST

DUCK LAKE INDIAN RESERVE

Echo Lake

Echo Creek

WRINKLY FACE CLIFF

Kelowna Airport

Lightblue Lake

Walroy Lake

Robert Lake

Creek

Motel

Pumping Station

Water Gate

Reservoir

Sawmill

Lumber Yard

Kelowna City Limits Gate

Air Beacon

Air Beacon 2412

Air Beacon 2030

Recreation Centre

Senior Citizens Homes

Dump

Nursery

Sawmill Campground

Pumphouse

Settling Pond

Pipeline

Gas Pipeline

Power Line

City Limits

Boat Launch

Picnic Site

Rockfade

Vineyard on the shores of Okanagan Lake

4. SUITABILITY CLASSIFICATION FOR GRAPE PRODUCTION IN THE OKANAGAN AND SIMILKAMEEN VALLEYS

4.1 INTRODUCTION

The maps in this section of the Atlas were developed on the basis of growing season information. They are presented to provide guidance and direction to the grape and wine industry in the Okanagan and Similkameen Valleys of British Columbia in site selection and grape variety selection. Site and variety selection are basic decisions that grape growers must make. The viability of the vineyard afterwards depends to a large degree on the extent to which marketing of the crop and management of the vineyard are taken into consideration. Careful use of the maps and the supporting information in the other sections of the Atlas will allow producers to optimize grape quality and production; will allow wineries to estimate the quality of grapes that can reasonably be expected from a given site; will provide a basis for the selection of grape variety for future evaluation programs and will provide a basis for the formation of appellation areas.

This section establishes a relationship between climate, soils and grape varieties. The methods used to establish the relationship between climate and climate and soils are outlined in the tables of Appendix B. Local knowledge about grape variety characteristics such as variations in hardiness and season of maturity with well tested varieties such as Concord, Campbell Early, De Chaunac (S-9549), Marechal Foch, Okanagan Riesling and Verdelet (S-9110) has been used to establish the relationships between grape varieties, climate and soils.

4.2 CHARACTERISTICS OF THE SUITABILITY CLASSES FOR GRAPE PRODUCTION

4.2.1 Class 1

Land areas in this class are the most desirable and are the least restrictive for grape production. Class 1 areas have the highest number of heat units, a long frost free season, high solar radiation and desirable soil characteristics. Land in Class 1 is therefore capable of producing the widest range of grape varieties. Varieties such as Chancellor (S-7053), Vineland 50201, Johannisberg Riesling, and White Riesling and late maturing high acid producing varieties are most likely to produce the best fruit quality and mature wood in this class. Limitations because of the high solar radiation and the high number of growing degree days exist for low acid/low sugar producing varieties such as Madelaine Sylvaner and Perle of Csaba.

The major locations for Class 1 areas in the Similkameen Valley and the Okanagan Valley are predominantly on the east side of these valleys. Less extensive Class 1 areas are found on the west side of these valleys, a result of shading produced by mountains. Exceptions occur at Skaha Lake; on the south facing slope of Mt. Boucherie and a few small areas in the most northern portion of the Atlas.

Some anomalies do exist, particularly on the east side of Osoyoos Lake extending south to the U.S. border and northward to Oliver. This area contains east facing slopes that meet the upper terraces. These slopes could form air collection sites that are too small to map. Such areas are prone to early fall frost. Caution should be used in selecting varieties for these areas.

Varieties such as De Chaunac (S-9549), Chelois (S-10878), Verdelet (S-9110), Pinot Chardonay, Semillon, Chenin Blanc, Gray Riesling, Merlot, Cabernet Sauvignon, Sauvignon Blanc and Pinot Noir planted (without rootstocks) on the sandy sols of this class in areas south of Vaseaux Lake had mortally damaged root systems after the 1978/79 winter. Marechal Foch, White Riesling, Gewurztraminer, Vineland 50201 and Rougeon (S-5898) were not seriously damaged while Okanagan Riesling was moderately injured.

Class 1 areas located in the Inkameep Creek Valley appear to represent an extensive area suitable for grape production. However, there is no grape growing experience or winter temperature information available for this area.

Broad areas of land, as yet unplanted to vineyards or orchards are found in Class 1, suggesting that expansion of the grape and wine industry in this class is possible.

4.2.2 Class 2

Land areas in this class are desirable, but somewhat more restrictive for grape production. This class contains fewer growing degree days; has a slightly shorter frost free season and has lower solar radiation than areas in Class 1. The soils of land areas in this class are the same as those found in Class 1. Class 2 areas are therefore capable of producing a slightly more narrow range of grape varieties. It is more difficult to produce good quality later maturing varieties, especially in cool summers in areas north of Summerland. High acid producing varieties such as Baco Noir, Marechal Foch, Chenin Blanc and White Riesling will produce a greater imbalance of sugar and acid content in this class. Low acid/sugar producing varieties will produce better quality fruit in the northern portions of this class.

The major portions of Class 2 areas are located near the town site of Keremeos in the Similkameen Valley; the east side of the Okanagan Valley south of Oliver; the east side of this valley north of Oliver to Kelowna and along west or south facing slopes in areas around Kelowna.

Anomalies in this class are somewhat more extensive than in Class 1. The Class 2 area located in the Inkameep Creek Valley requires a word of caution for the reasons outlined earlier in Class 1. Land at the south end of Vaseaux Lake reflects an unusual location for a Class 2 because it is found in a valley bottom. Valley bottoms are usually cool air collecting areas; prone to early fall frost and severe winter low temperatures. Continued air movement through this particular area due to the narrow shape of the valley at this point may influence and improve the climate in this location.

A broad exposure of Class 2 drains Shingle Creek on the west side of Penticton. This area, acts to ameliorate the effects of cold air collected in the mountains. There is no experience in grape production and there are no winter temperature records available for this location.

The land areas around Summerland contain numerous side valleys, rock outcroppings and air drainage channels from surrounding mountains. This very diverse topographic area produces areas which appears to be satisfactory grape growing sites but which have proven, historically, to be unsuitable. Such locations are located in the large Class 2 area at the extreme western portion of Summerland and the Eneas Creek Valley (locally known as Garnet Valley).

As was found in Class 1, there appears to be large areas of land in Class 2 areas suitable for grape production which have not yet been planted to vineyard or orchard. Expansion of the grape and wine industry in this class is possible.

4.2.3 Class 3

Land areas within this class are suitable for grape production but are restrictive for the production of good quality grapes. Limitations on grape production in this class make very careful site selection mandatory. This class has the lowest number of acceptable heat unts, a high degree of risk for early fall frost and low solar radiation. It also contains a much broader selection of soils with desirable to acceptable characteristics. Late maturing or high acid producing varieties should not be grown while early maturing varieties such as Madeleine Sylvaner and Pearl of Csaba produce acceptable balance of sugar and acid content in this class. Good sites within Class 3 areas are best suited to varieties which mature before the end of the lst week of October.

Class 3 areas are predominantly located at lower elevations in the Similkameen Valley and the west side of the Okanagan Valley from Osoyoos to Kelowna. In the Kelowna area Class 3 represents the major portion of the grape producing area extending from near lake level to terraces at higher elevations. A major area of Class 3 is located adjacent to Okanagan Lake at Winfield and represents an area where the moderating influence of Okanagan Lake improves grape production. Land in this area, from lake level to the height of land to the east of Okanagan Lake is more favourably exposed than sites from the height of land east to Highway 97. The area near Okanagan Lake represents the better portions of a Class 3 while the area near Highway 97 represents a poor Class 3.

Much of the land in Class 3 is currently planted to grapes and other crops. There are still some heavily forested areas within the Class 3 area. Expansion of the grape and wine industry can take place in this class.

4.2.4 Class 4

Land within this class represents the greatest challenge to grape growers. Class 4 areas may have high accumulation of growing degree days or high solar radiation or desirable soil characteristics, but the disadvantages out weigh the advantages. Land in Class 4 is the most restrictive for grape production. Suited to portions of this class are some

early maturing, hardy varieties such as Selection # 65 (Sovereign Gold), Selection # 123 (Sovereign Tiara), Sovereign Coronation (Sel. 361), Leinor white and Pearl of Csaba.

Class 4 areas are found in the valley bottom of the Similkameen and Okanagan Valleys. They are also found at the higher elevations near Westbank, Kelowna and extensive areas north of Kelowna. Extreme caution should be used when selecting sites with this class for grape production. Historically valley bottoms have been very vulnerable to cold winter temperatures. Areas north of Kelowna have also been extremely cold during the winter months. Areas at higher elevations have suffered from early fall freeze and cooler growing seasons.

While there are large areas of land not planted to vineyards, expansion of the grape and wine industry using land within this class is not recommended.

4.2.5 Class 5

Most areas within this class are represented by extensive rock outcropping, very steep hillsides, city centers, areas prone to flooding or beach areas. Grape production in this class may be possible where pockets of suitable soil, too small to be mapped exist, or where special management practices are used.

Generally areas in Class 5 are not considered suitable for grape production.

4.3 GRAPE VARIETIES

Flawless grape quality can only be produced with flawless grapes on a flawless site. It is not possible to produce such grapes because of the demands that are placed on site and varieties. These demands may change. Sites considered marginal for one variety may be abandoned or may be considered acceptable as the demand for other varieties increases. Sites considered to be excellent may become only fair with a change in demand. Variations in climate may produce the best quality fruit in cool areas during hot years, or may produce the best fruit quality in hot areas during cool years.

Rapid changes in the demand for grape varieties not previously grown in this area, emphasize the need for knowledge about the sites and soils selected for grape production. During these periods of rapid change, grape growers plant varieties and adopt management practices that have not previously been evaluated in British Columbia. These unknowns impose a greater degree of risk.

Grape variety recommendations have historically considered varieties that could be grown on many different sites in the Atlas area. Climate, soil and variety differences in various areas are now being utilized more fully as the demand for new varieties and higher quality grapes increases. Table 28 lists some of the well tested and newer varieties with limited evaluation that are now produced in the Atlas area. This listing is not a list of recommended varieties, but rather a listing of variety suitability to particular areas on the basis of existing knowledge. Some of these evaluations may change as additional experience with the varieties is gained.

Table 28
Suitability Classification for Grape Varieties
in the Okanagan and Similkameen Valleys

VARIETY	SUITABILITY CLASS				
	1	2	3	4	5
Aurora (S-5279)	S	S	M	N	N
Auxerois	M	S	S	N	N
Baco Noir	S	S	M	N	N
Campbell Early	S	S	S	M	N
Cayuga white	M	S	M	N	N
Chancellor (S-7053)	S	S	N	N	N
Chelois (S-10878)	S	S	N	N	N
Chenin Blanc	M	M	N	N	N
Concord	S	S	S	N	N
De Chaunac (S-9549)	S	S	M	N	N
Ehrenfelser	S	S	S	M	N
Festivee (V-53033)	S	S	N	N	N
Gamey Beaujolais	S	S	M	N	N
Gewurztraminer	S	S	N	N	N
G M 4-46	S	S	M	N	N
Johannisberg Riesling	S	S	M	N	N
Madeleine Sylvaner	M	S	S	M	N
Marechal Foch	S	S	M	M	N
Muller Thurgau	S	S	N	N	N
Pearl of Csaba	M	S	S	M	N
Pinot Chardonnay	M	M	N	N	N
Pinot Noir	S	S	M	N	N
Okanagan Riesling	S	S	S	M	N
Rotberger	S	S	S	N	N
Rougeon (S-5898)	S	S	N	N	N
Rulander KL2-21	S	S	M	N	N
Selection #65 (Sovereign Gold)	S	S	S	M	N
Selection #82 (S. Ruby)	S	S	S	M	N
Selection #123 (S. Tiara)	S	S	S	M	N
Selection #166 (S. Opal)	S	S	M	N	N
Selection #180 (S. Noir)	S	S	N	N	N
Schonburger	S	S	S	M	N
Seyval Blanc	S	S	S	N	N
Sovereign Coronation (#361)	S	S	S	M	N
Valerien (SV 23410)	S	S	N	N	N
Verdelet (S-9110)	S	S	N	N	N
Veeblanc (V-53263)	S	S	N	N	N
Vidal 256	S	S	N	N	N
Vineland 50201	S	S	N	N	N
Weisburgunder KL 5 GM	S	S	M	N	N
White Riesling	S	S	N	N	N

Footnote: S = Suitable
M = Marginal
N = Not Suitable

Suitability Class 1

Suitability Class 2

Suitability Class 3

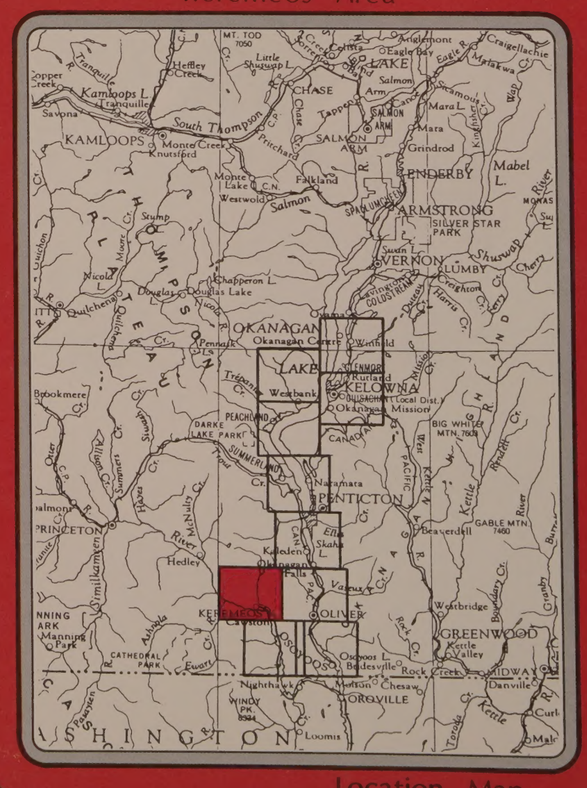
Suitability Class 4

Suitability Class 5

Scale 1:50 000

GRAPE SITE SUITABILITY

Keremeos Area



Location Map

49°20'00"

120°00'00"

KEREMEOS FORKS
INDIAN RESERVE 12A

Keremeos Forks
Indian Reserve 12

KEREMEOS COLUMNS
PROVINCIAL PARK

ASHNOLA
INDIAN RESERVE 10

ASHNOLA IR 10E

ALEXIS
IR 9

BLIND
CREEK
IR 6

Twin Lakes

Abandoned

Village Limits

Trailer
Pk.

Fairgrounds

Gas Pipeline

Transformer
Station

Tp 52

Tp 52

49°10'00"

119°43'00"

Suitability Class 1

Suitability Class 2

Suitability Class 3

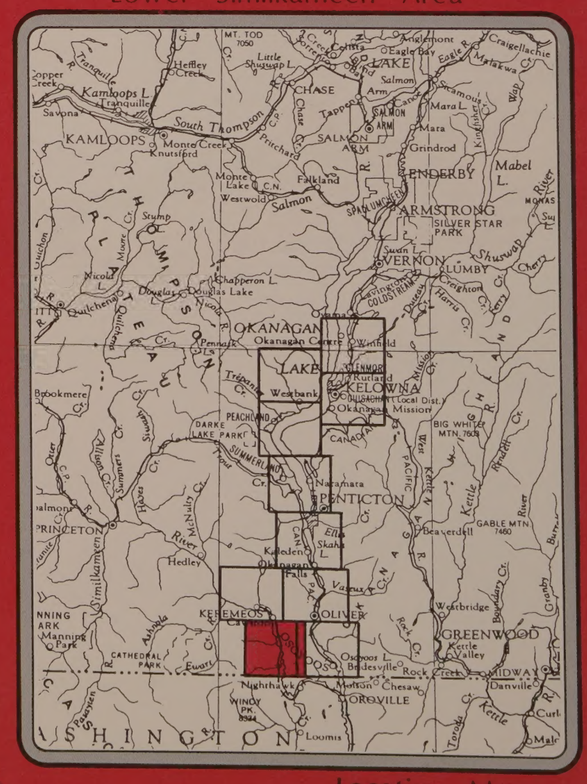
Suitability Class 4

Suitability Class 5

Scale 1:50 000

GRAPE SITE SUITABILITY

Lower Similkameen Area



Location Map

49°10'00"

119°52'00"

ASHNOLA

INDIAN RESERVE 13

PROVINCIAL

FOREST

FARM

IR 4

IR 2

LOWER SIMILKAMEEN

SIMILKAMEEN

SKEMEOSH 1 A

INDIAN RESERVE 8

SKEMEOSH 1

INDIAN RESERVE 7

RICHTER MOUNTAIN

OKANAGAN

PROVINCIAL

FOREST

OKANAGAN

PROVINCIAL FOREST

Mount Kobau

Golf Course

Television

Radio Obs

Water Tower

Transformer Station

Mine Waste

Gate

Richter L.

Frank L.

Hunter Creek

Susap Creek

Robert Creek

Boundary Creek

Tinhorn Creek

Hester Creek

Testalinden Creek

Swan Creek

Spouse Creek

Snehumption Creek

Similkameen

Chopaka

CANADA

BRITISH COLUMBIA

49°00'00"

119°35'00"

Suitability Class 1

Suitability Class 2

Suitability Class 3

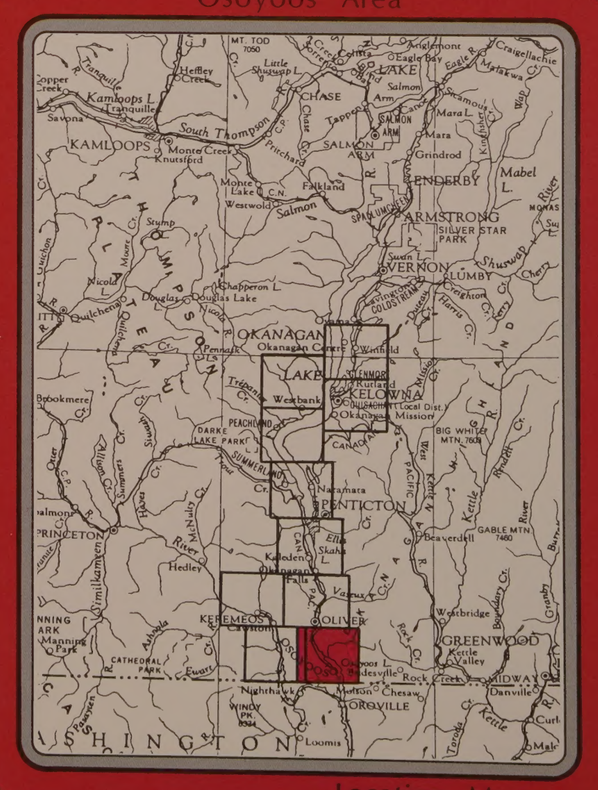
Suitability Class 4

Suitability Class 5

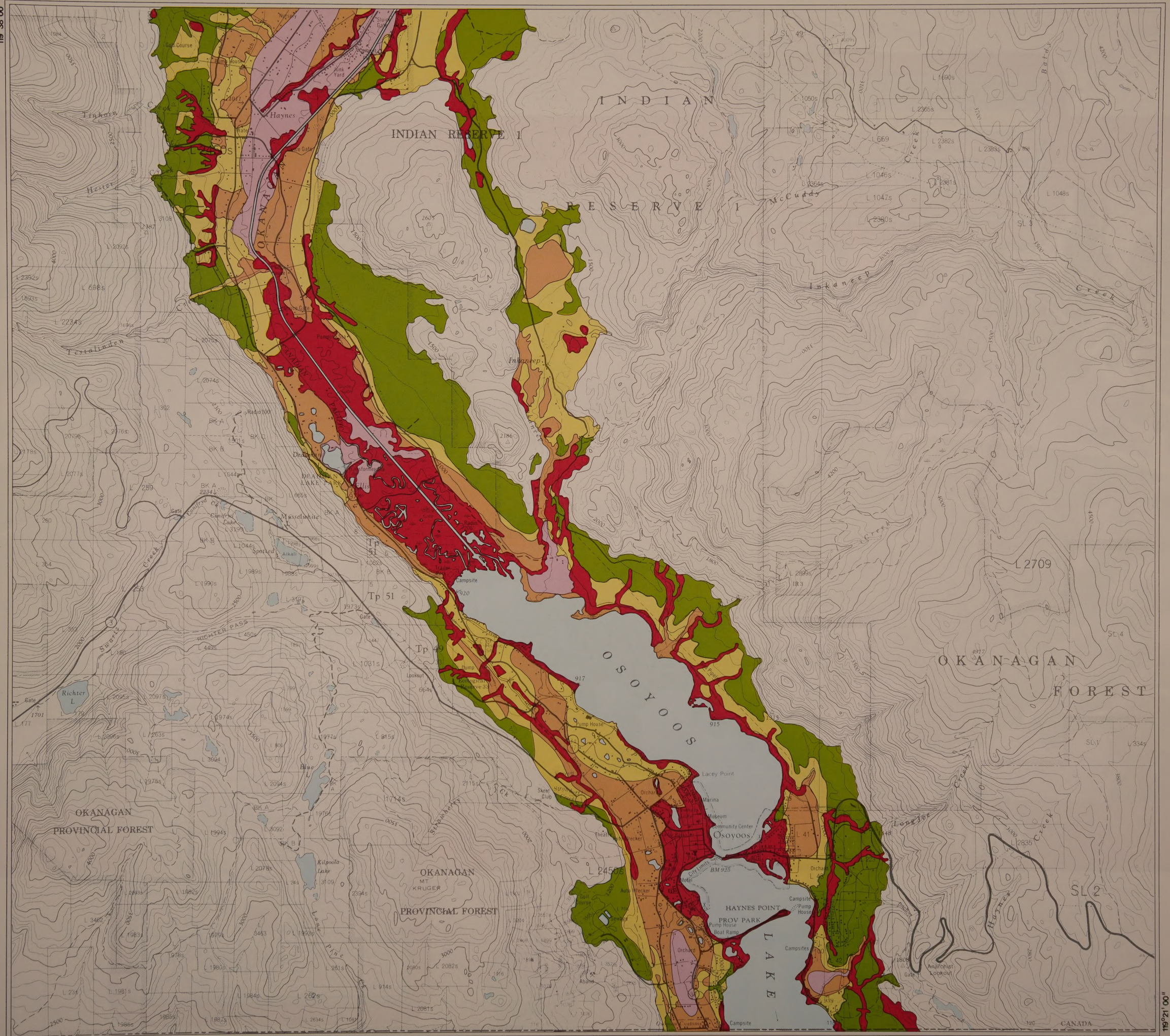
Scale 1:50 000

GRAPE SITE SUITABILITY

Osoyoos Area



Location Map

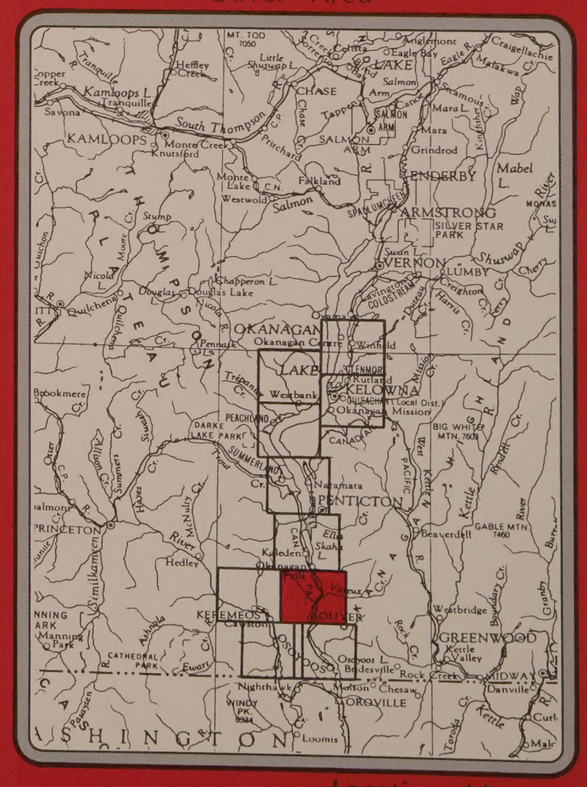

49°10'00"
119°38'00"
INDIAN RESERVE 1
INDIAN RESERVE 1
OKANAGAN
OSOYOOS
LAKE
OKANAGAN
FOREST
OKANAGAN
PROVINCIAL FOREST
OKANAGAN
MT KRUGER
PROVINCIAL FOREST
HAYNES POINT
PROV PARK
Osoyoos
Haynes
Tinhorn Creek
Hester Creek
Testalinden Creek
McCuddy Creek
Inkaneep Creek
Swamp Creek
Shingle Creek
Lonesto Creek
Haynes Creek
Richter Pass
Richter L
Blue L
Kilpoola Lake
Conniford Lake
Dead Horse L
Aikali
Musselwhite
Lacey Point
Marina
Museum
Community Center
Golf Course
Campsite
Campsites
Boat Ramp
Pump House
Auto Wrecker
Motel
Orchard
Skeet Club
Theatre
Sewage
Dump
Lookout
Anarchist Lookout
Radio Tower
Gate
Tp 51
SL 1
SL 2
SL 3
SL 4
CANADA
49°00'00"
119°21'00"

Suitability Class 1
Suitability Class 2
Suitability Class 3
Suitability Class 4
Suitability Class 5

Scale 1:50000

GRAPE SITE SUITABILITY

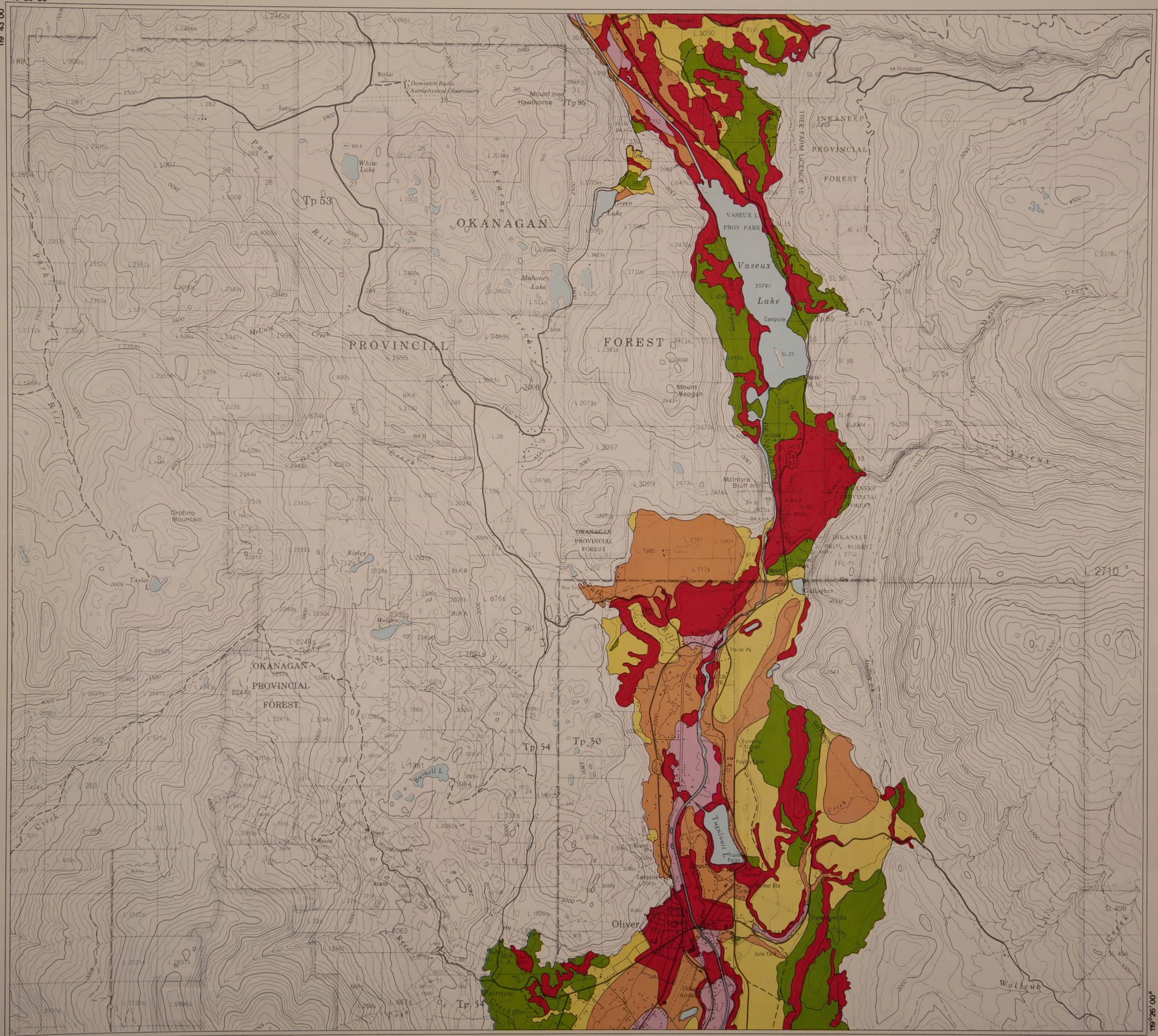
Oliver Area



Location Map

49°20'00"

119°43'00"



49°10'00"

119°26'00"

Suitability Class 1

Suitability Class 2

Suitability Class 3

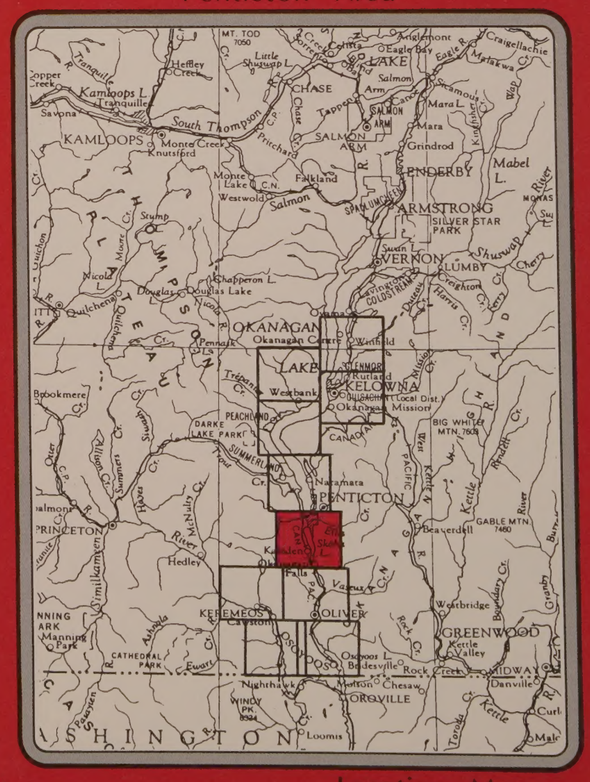
Suitability Class 4

Suitability Class 5

Scale 1:50 000

GRAPE SITE SUITABILITY

Penticton Area



Location Map

49°30'00"

119°45'00"

OKANAGAN PROVINCIAL FOREST

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PENTICTON

OKANAGAN

INDIAN RESERVE 1

SKAHA LAKE

1108±

PROVINCIAL FOREST

OKANAGAN PROVINCIAL FOREST

Tp 88

Shingle Creek

Fahlegh Lake

Skaha Creek

Gillies Creek

Stewart Creek

Derenzy Lake

Aeneas Lake

Marron River

Marron Lake

Marron Valley

Kitley Lake

Trout Lake

Platteau Lake

Mount McLellan

Christie Memorial Park

Penticton Indian Band Campsite

Penticton Golf Course

Penticton Radio Control Flying Club

Penticton Trailer Park

Penticton Marina

Penticton Hospital

Penticton Museum

Penticton Zoo

Penticton Pumphouse

Penticton Water Treatment Plant

Penticton Sawmill

Penticton Rifle Range

Penticton Gas Pipeline

Penticton Dump

Penticton Gravel Pit

Penticton Lookout

Penticton Trans Mtn Oil Pipeline

Penticton Water

Penticton Creek

Penticton Indian Band Campsite

Penticton Indian Band Golf Course

Penticton Indian Band Trailer Park

Penticton Indian Band Gravel Pit

Penticton Indian Band Water

Penticton Indian Band Pumphouse

Penticton Indian Band Dump

Penticton Indian Band Lookout

Penticton Indian Band Trans Mtn Oil Pipeline

Penticton Indian Band Gas Pipeline

Penticton Indian Band Rifle Range

Penticton Indian Band Radio Control Flying Club

Penticton Indian Band Trailer Park

Penticton Indian Band Marina

Penticton Indian Band Hospital

Penticton Indian Band Museum

Penticton Indian Band Zoo

Penticton Indian Band Pumphouse

Penticton Indian Band Water Treatment Plant

Penticton Indian Band Sawmill

Penticton Indian Band Rifle Range

Penticton Indian Band Gas Pipeline

Penticton Indian Band Dump

Penticton Indian Band Gravel Pit

Penticton Indian Band Lookout

Penticton Indian Band Trans Mtn Oil Pipeline

Penticton Indian Band Water

Penticton Indian Band Creek

119°28'00"

49°20'00"

Suitability Class 1

Suitability Class 2

Suitability Class 3

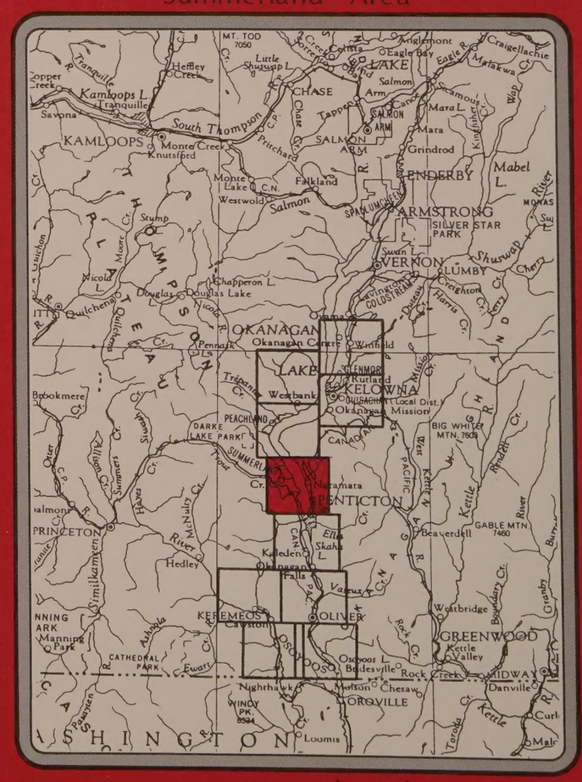
Suitability Class 4

Suitability Class 5

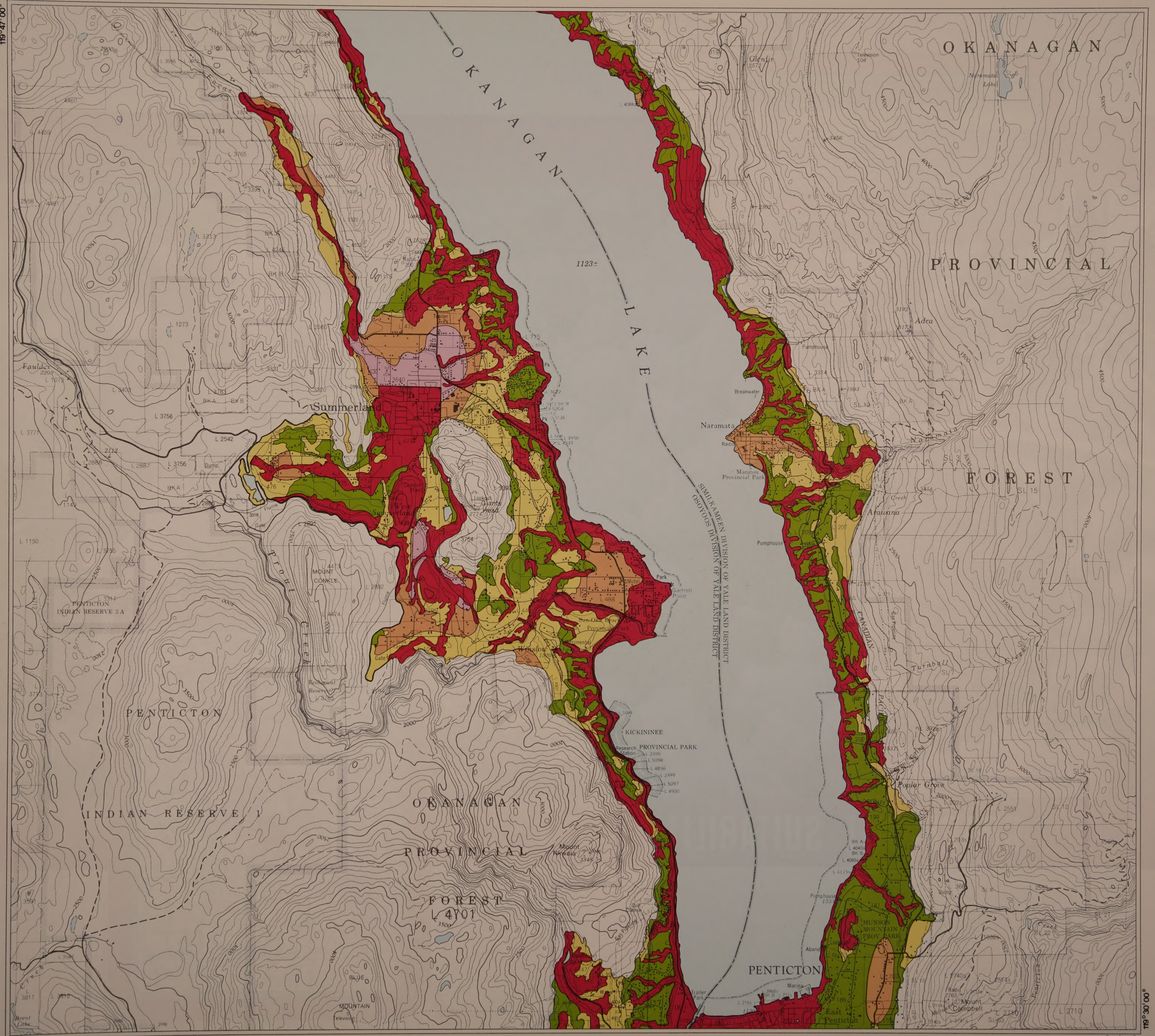
Scale 1:50 000

GRAPE SITE SUITABILITY

Summerland Area



Location Map

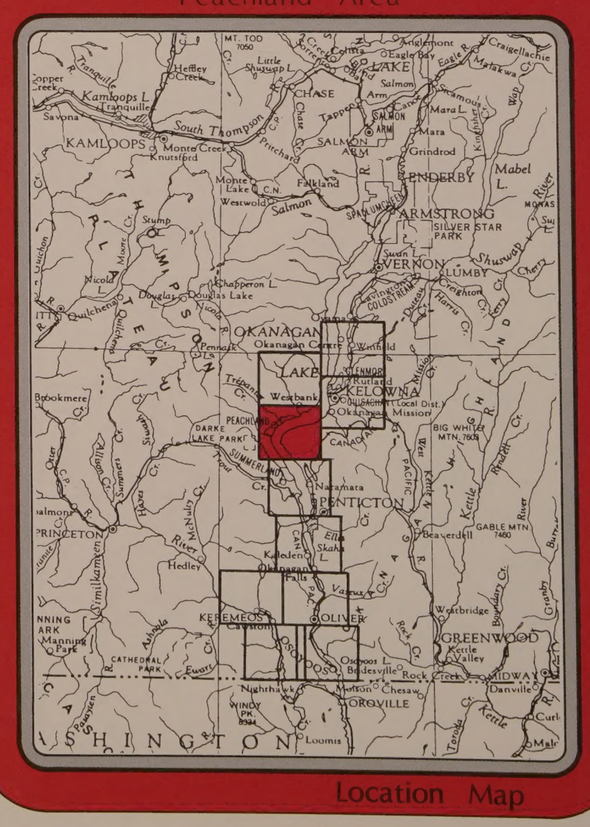

49°40' 00"
119°47' 00"
OKANAGAN
LAKE
1123±
OKANAGAN
PROVINCIAL
FOREST
Summerland
Naramata
Adra
Glentir
Naramata Lake
Television 104
Breakwater
Manitou Provincial Park
Araluana
Pumphouse
Faulder
Golf Course
Trailer Park
Arena
Dump
Cement Plant
Giants Head
Motel
Park
Gartrell Point
Sun-Oka Beach Provincial Park
Elementary
Winslow
Gate
Flume
Radio
Lookout
Creek
Road
Pumphouse
Mount Conkle
Penticton Indian Reserve 3A
Penticton Indian Reserve 1
Penticton
Kickininee Provincial Park
Research Station
Mount Nkwala
Blue Mountain
Television
Munson Mountain Prov. Park
Abandoned
Marina
East Penticton
Mount Campbell
Radio
Poplar Grove
Turnbull
Canadian Pacific
Gas Pipeline
Spring
Dump
Trailer Park
Dock
Campground
Research Station
Recreational Reserve
SIMILKAMEEN DIVISION OF YALE LAND DISTRICT
OSOYOOS DIVISION OF YALE LAND DISTRICT
49°30' 00"
119°30' 00"

Suitability Class 1
Suitability Class 2
Suitability Class 3
Suitability Class 4
Suitability Class 5

Scale 1:50 000

GRAPE SITE SUITABILITY

Peachland Area



49°50'00"

119°49'00"

Mount Law

Mount Drought

Mount Coldham

McCall Lakes

Spring L.

PINCUSHION MTN

Trepanier

Gellatly

Marina

Tree Nursery

Trailer Park

Camp

L A K E

O K A N A G A N

1123±

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

PEACHLAND DISTRICT MUN

Peachland

Dump

Trailer Park

Antlers Beach Provincial Park

Lookout

Rattlesnake Island

Squally Point

WILD HORSE CANYON

Creek

Greata

Mount Eneas

Gillard Lake

VALLEY

OKANAGAN LAKE PROVINCIAL PARK

Lookout

Commando Bay

OKANAGAN MOUNTAIN

PROVINCIAL PARK

Norman L.

Raker Lake

Okanagan Mountain

Mtn Radar Sta

Divide Lake

Gemmill Lake

Chute Lake

TP 28

Kelowna City Limits

L 2711

49°40'00"

119°32'00"

Suitability Class 1

Suitability Class 2

Suitability Class 3

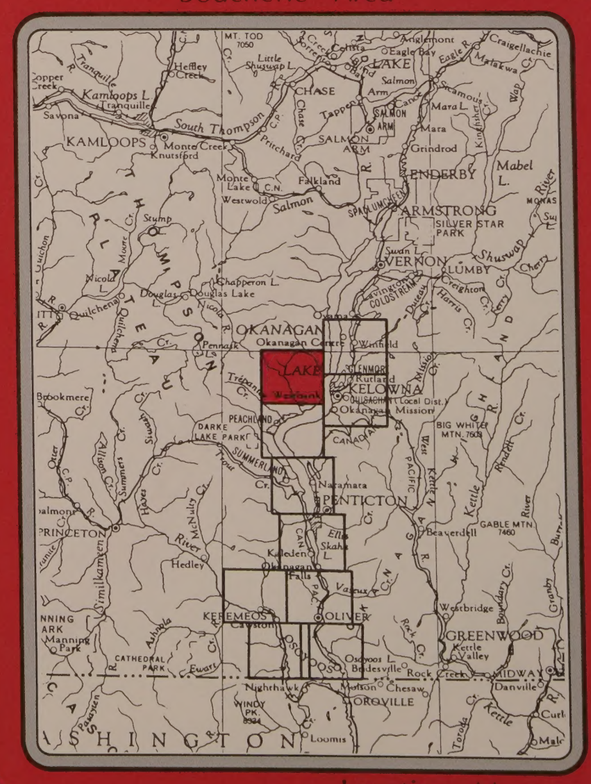
Suitability Class 4

Suitability Class 5

Scale 1:50 000

GRAPE SITE SUITABILITY

Boucherie Area



Location Map

50°00'00"

119°49'00"

WEST OKANAGAN PROVINCIAL FOREST

PROVINCIAL FOREST

TSINSTIKEPTUM INDIAN RESERVE 9

TREE FARM LICENCE 9

Dobbin L.

Iklahi Lake

Bit Creek

Lily L.

Paynter Lake

Banana L.

Jackpine L.

Lambly Lake

Lambly Ck

Mount Swite

Carrot Mountain

McDougall Creek

Hayman L.

Rose Valley Lake

Mount Boucherie

Mount Last

Mount Clements

Mount Miller

Glenrosa

Television

Ski Lift

Hydraulic Creek

Powers Creek

Hihium Creek

Duteau Creek

Peachland Creek

Trailer Park

Tree Nursery

Control Gate & Dam

Asphalt Plant

Cement Plant

Pumphouse

Poultry Farm

Gate

Ditch

Dump

Airstrip

Water Tank

Shannon Lake

Ellis Creek

Jack Creek

Vernon Creek

Ashton Meadows Creek

Shingle Creek

Reid Ck

Bear Rock Creek

Hihium Creek

Duteau Creek

Peachland Creek

Ellis Creek

Jack Creek

Vernon Creek

Ashton Meadows Creek

Shingle Creek

Reid Ck

Bear Rock Creek

49°50'00"

119°32'00"

Suitability Class 1

Suitability Class 2

Suitability Class 3

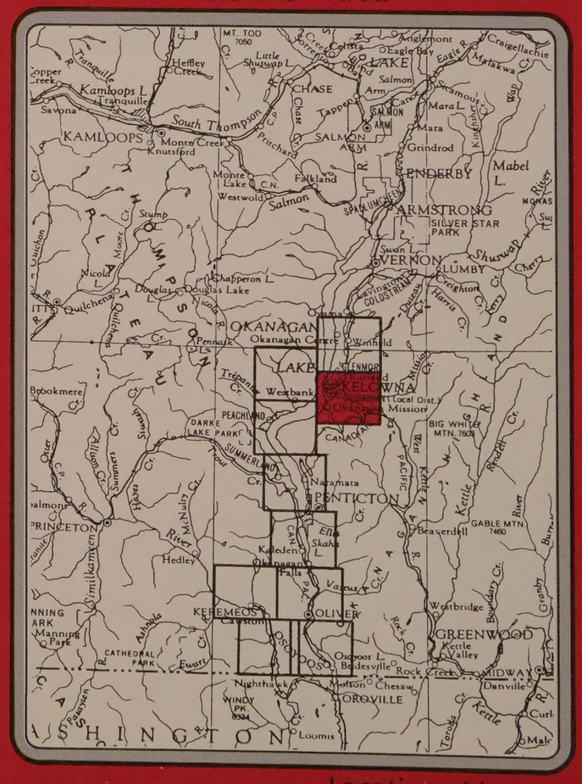
Suitability Class 4

Suitability Class 5

Scale 1:50 000

GRAPE SITE SUITABILITY

Kelowna Area



Location Map

49°56'00"

119°32'00"

KELOWNA

Westside

Okanagan Lake

Rutland

East Kelowna

Okanagan Mission

Black Knight Mountain

Knox Mountain Park

Mount Knox

Mount Dilworth

Rutland Community Provincial Park

Mission Prov Pk

Tp 25

Tp 26

Tp 27

Tp 28

Tp 29

OSOYOOS DIVISION OF YALE LAND DISTRICT

SIMILKAMEEN DIVISION OF YALE LAND DISTRICT

CANADIAN PACIFIC

Hydraulic

Bulman Creek

Mission Creek

Fascieux Creek

Adobe Creek

Powers Creek

49°46'00"

119°15'00"

Suitability Class 1

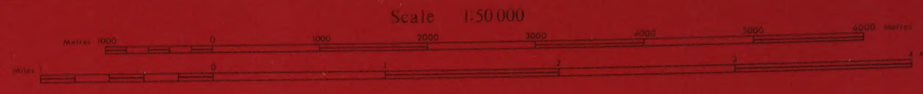
Suitability Class 2

Suitability Class 3

Suitability Class 4

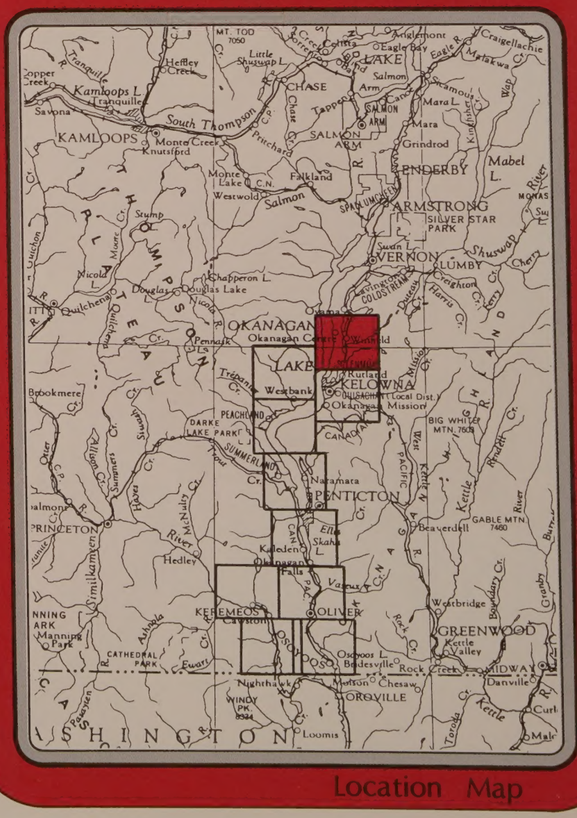
Suitability Class 5

Scale 1:50 000



GRAPE SITE SUITABILITY

Winfield Area


MT. TOD 7050
Eagle Bay
LAKE
CHASE
Salmon Arm
Kamloops L
Tranquille
Savona
KAMLOOPS
South Thompson
Monte Creek
Knutsford
SALMON ARM
Mara L.
Grindrod
ENDERBY
Mabel L.
Falkland
Monte Lake
Westwold
Salmon
ARMSTRONG
SILVER STAR PARK
VERNON
LUMBY
Shuswap
Okanagan Centre
OKANAGAN
LAKE
KELOWNA
Westbank
Okanagan Mission
PEACHLAND
DARKE LAKE PARK
SUMMERLAND
Naramata
PENTICTON
BIG WHITE MTN. 7650
GABLE MTN. 7400
PRINCETON
Hedley
Kaleden
Okanagan Falls
KEREMEOS
OLIVER
Osoyoos L.
Oroville
GREENWOOD
Kettle Valley
MIDWAY
Danville
Curl
Loomis
WINDY PK. 8324
CATHEDRAL PARK
Manning Park
Brookmere
Tulameen
Similkameen
Kettle
Granby
Boundary Cr.
Rock Creek
Waterbridge
Beaverdell
Ellis L.
Skaha L.
Vaseux L.
Nighthawk
Chesaw
Loomis
Tunk
Tulameen
Coquihalla
Nicola
Douglas Lake
Chapperon L.
Stump
Quilchena
Penask
Trepanier
Westbank
Canada
Summerland
Naramata
Penticton

50°06'00"

119°32'00"

Nahun

OKANAGAN PROVINCIAL FOREST

Caesars

Okanagan Centre

Wood Lake

Winfield

Woodsdale

Ellison Lake

Wilson Landing

OKANAGAN LAKE

Traders Cove

Horseshoe Gulch

Girl Guide Camp

TFL 8

TREE FARM LICENCE 8

WEST OKANAGAN PROVINCIAL FOREST

Postill

Lightblue Lake

Walroy Lake

Robert Lake

Ellison

Tp 21

Tp 23

Tp 24

WRINKLY FACE CLIFF

Echo Lake

Kelowna Airport

Kelowna Creek

Wilkinson Creek

Rockface Creek

1123±

49°56'00"

119°15'00"

Grape Nursery Stock near Vaseux Lake

SUMMARY

Suitability classifications for grape production in the Okanagan and Similkameen Valleys of British Columbia are presented in narrative and map form. Existing land use and farm management techniques are not considered in the classifications. Five suitability classes show the relationship between grape varieties, growing season climatic conditions, and soils. A historical progression of events in the grape industry; detailed descriptions of climate and soil themes as these relate to grape growing; summary information for selected climate stations; combinations of climate and climate and soil themes are also presented.

HISTORICAL PHOTO. Shipment of Wine Grapes

GLOSSARY OF TERMS

Aeration - the process by which air in the soil is replaced by air from the atmosphere

Autumn freeze risk - the percentage chance of having a freeze on or before a certain designated date in autumn

Available water storage capacity - the capacity of a soil to store water that can be readily absorbed by plant roots

Bases - positively charged metallic cations such as calcium, magnesium, sodium and potassium that are usually found on the soils' exchange sites

Calcareous soil - soil containing sufficient calcium carbonate (usually lime), often with magnesium carbonate to release carbon dioxide gas when treated with cold 0.1 N hydrochloric acid

Cations - nutrients held on the exchange complex and are usually available to the plant

Chlorosis - yellowing of green coloration in plants

Cutting - an unrooted portion of grape cane used to make new plants

Extract, soil - the solution separated from a soil suspension or from a soil by filtration, centrifugation, suction or pressure

European Loop System - a training system for vines in which canes left at pruning are bent down to form half circles

Fan Apex - the highest elevation area of a fan landform

Fan Toe - the lowest elevation area of a fan landform

Field Capacity - the percentage of water remaining in the soil 2 or 3 days after the soil has been saturated and free drainage has practically ceased

Fragment - a solid mineral particle larger than 2 mm in size

Friable - a consistance term pertaining to the ease of crumbling of soils

Frost Pocket - an area susceptible to the collection of cool air

Geological - pertaining to the science of geology

Glacial Till - unstratified glacial drift deposited directly by the ice and consists of clay, sand, silt, gravel and boulders intermingled in any proportion

Groundwater - water that is passing through or standing in the soil and the underlying strata. It is free to move by gravity.

Growing Degree Days - A measure of the accumulation of the mean daily temperature above the minimum threshold temperature for plant growth. In the case of grapes the standard threshold is 10°C.

Hardy - the ability of vines to withstand cold temperatures

Heliotropism - the tendency of some organisms to move to or turn toward or away from the sun

Imperfectly Drained - the soil moisture in excess of field capacity remains in subsurface soil horizons for moderately long periods during the year

Isotherm - a line on a map connecting points of equal temperature.

Kniffen Trellis - a trellis consisting of two wires, one above the other

Leaching - the removal from the soil of materials in solution

Linear Regression - a statistical method for estimating one variable from one or more related variables (e.g. Growing degree days from elevation)

Matrix, Soil - the main soil constituent or material that encloses other soil features

Microclimate - the fine climatic structure of the air space that extends from the very surface of the earth to a height at which the effects of the immediate character of the underlying surface no longer can be distinguished from the general local climate.

Milliequivalent - The 1/1000 part of an equivalent weight of an element. The equivalent weight of a soil colloid is the weight of clay or organic colloid that has a combining power equal to 1 gram - atomic weight of hydrogen.

Moraine - an accummulation of earth, generally with stones, carried and finally deposited by a glacier. Several kinds of moraines are distinguished, such as ground moraine, end moraine and terminal moraine.

mS/cm or milli-Siemens/cm - the measure of electrical conductance over a distance of 1 cm in solution (electrolite)

Organic Matter - the organic fraction of the soil includes plant and animal residues at various stages of decomposition

Orographic - of, pertaining to, or (frequently in meteorology) caused by mountains

Percolation - the downward movement of water through soil

Perviousness - the potential of a soil to transmit water internally, as inferred from soil characteristics

Phenology - the study of the timing of recurring natural phenomena such as the flowering of tree or freezing of a river

Photostimulus - a light form that influences the activity of an organism as a whole or in any of its parts

Photosynthesis - process in green plants that uses water and carbon dioxide in the presence of light to produce sugars, oxygen and energy

Plastic Soil - a soil capable of being molded or deformed continuously and permanently into various shapes by moderate pressure

Pores - the part of the bulk soil volume not occupied by soil particles

Post-glacial - pertaining to the time since the latest glacial time; not related to meltwaters that originated from glaciers during the glacial time

Radiation - energy propagated through space in the form of an advancing disturbance in electric and magnetic fields existing in space. In the atlas we are concerned primarily with visible and infared radiation.

Reclamation - bringing into agricultural use of otherwise idle non productive land

Relief - elevations or inequalities of a land surface, considered collectively

Respiration - oxidation in plant cells of organic material with the production of water, carbon dioxide and energy.

Salinity - the amount of soluble salts in a soil, expressed in terms of percentage, part per million, or other convenient ratios

Sinkhole - a subterranean cavern caused by erosion of subsoil material with final collapse of surface due to running water

Soil Parent Material - the unconsolidated and more or less chemically weathered mineral or organic matter from which a soil has developed by pedogenic processes

Solar Radiation - the total electromagnetic radiatiton emitted by the sun

Standard error of estimate - degree of precision in an estimated variable. The smaller the standard error the more precise will be the predictions.

Stickiness - the quality or degree of adhesion to other objects or materials

Structure - the combination or arrangement of primary soil particles into secondary particles, units or peds

Subsoil - a general term for the layer of soil or surficial geologic deposit that underlies the surface and subsurface soil layers. It begins at about 50 cm (1.5 ft) below the soil surface and continues downward for about 100 cm (3 ft)

Synoptic - the use of meteorological data obtained simultaneously over a wide area for the purpose of presenting a comprehensive picture of the state of the atmosphere

Terminal moraine - an accumulation of unsorted materials formed across the course of a glacier at its farthest advance or at places marking the termination of important glacial advances

Texture, soil - the relative proportions of the various mineral soil separates in a soil as described by the classes of soil texture

Thermal imagery - the record of variations in the amount of heat given from objects at a particular location at certain wave lengths (infra-red) longer than that of visible light

Thermal conductivity - the rate of heat transfer to or from a point in the soil

Topoclimate - The climatology of a terrain. This is intermediate in scale between microclimate and macroclimate and is generally taken to mean the climate in a particular place, which depends not only on the confirmation of ground, but also on the type of soil and vegetation.

Transpiration - the process by which water in plants is transferred as water vapour to the atmosphere

Trellis - the structure on which grape plants are trained; usually made of posts and wires

T-bar Trellis - a trellis consisting of T-shaped posts with 2 to 4 horizontal support wires

Variety - different grape plants each distinguished by their own characteristics

Veneer - a layer of soil material less than 1 m (3 ft) thick overlying other soil materials or bedrock

Wilting point - the moisture content of a soil at which plants wilt and fail to recover their turgidity when placed in a dark humid atmosphere. The wilting point is commonly estimated by measuring the 15- bar percentage of a soil.

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APPENDIX A

CLIMATOLOGICAL DATA FOR SELECTED STATIONS

To assist those who require more detailed climatological information, the following data are presented. These average data are based on the 1951-1980 climate normals prepared by the Atmospheric Environment Service (1982a and 1982b). Users will note that "Days with Precipitation" is the sum of "Days with Rain" and "Days with Snow". On some occasions, such as when rain and snow occur on the same day, "Days with Precipitation" may be less than the sum. Also, "Days with Precipitation" may be greater than the sum if trace amounts (T) of precipitation (less than 0.1 mm of rain or 0.1 cm of snow) are recorded.

KEREMEOS 50° 12'N 119° 47'W 430 m	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Daily Maximum Temperature (°C)	-0.3	4.9	10.0	16.1	21.1	24.7	29.0	28.0	23.0	15.2	6.3	1.4	15.0
Daily Minimum Temperature (°C)	-6.5	-3.0	-0.2	3.9	8.2	11.8	14.2	13.8	9.7	4.2	-0.8	-4.3	4.3
Daily Temperature (°C)	**-3.4**	**1.0**	**5.0**	**10.0**	**14.7**	**18.2**	**21.6**	**20.9**	**16.4**	**9.7**	**2.8**	**-1.5**	**9.6**
Extreme Maximum Temperature (°C)	17.2	21.7	23.9	33.3	36.1	38.3	41.1	38.9	36.1	28.3	20.0	14.4	41.1
Extreme Minimum Temperature (°C)	-30.6	-30.0	-20.6	-8.3	-1.1	1.7	5.6	1.7	-5.0	-10.6	-21.7	-30.0	-30.6
Rainfall (mm)	8.9	8.1	9.5	14.1	20.6	27.1	20.3	22.2	12.8	10.6	12.2	11.6	178.0
Snowfall (cm)	22.8	9.7	3.0	0.2	0.0	0.0	0.0	0.0	0.0	0.4	8.0	20.0	64.1
Total Precipitation (mm)	**31.7**	**17.8**	**12.4**	**14.3**	**20.6**	**27.1**	**20.3**	**22.2**	**12.8**	**11.0**	**20.1**	**32.0**	**242.3**
Greatest Rainfall in 24 hours (mm)	27.4	12.7	15.7	29.7	25.4	32.0	28.7	49.3	29.5	52.1	32.5	27.4	52.1
Greatest Snowfall in 24 hours (cm)	16.5	28.4	27.2	2.0	0.3	T	0.0	0.0	T	15.2	31.8	27.9	31.8
Greatest Precipitation in 24 hours (mm)	34.5	28.4	27.2	29.7	25.4	32.0	28.7	49.3	29.5	52.1	32.5	35.3	52.1
Days with Rain	3	4	4	5	6	7	5	6	5	5	6	5	61
Days with Snow	8	3	1	0	0	0	0	0	0	0	2	6	20
Days with Precipitation	10	7	5	5	6	7	5	6	5	5	7	10	78

Freeze Free Period: 181 days

Average date of last spring freeze: April 18
Average date of first autumn freeze: October 17

OSOYOOS 49° 4'N 119° 31'W 331 m	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Daily Maximum Temperature (°C)	-0.6	4.0	10.0	16.5	21.5	25.2	29.1	27.8	22.4	14.8	6.2	1.4	14.9
Daily Minimum Temperature (°C)	-6.1	-3.1	-0.2	3.8	8.4	12.4	14.9	14.2	9.7	4.4	-0.1	-3.5	4.6
Daily Temperature (°C)	**-3.4**	**0.5**	**4.9**	**10.2**	**15.0**	**18.8**	**22.0**	**21.0**	**16.1**	**9.7**	**3.1**	**-1.0**	**9.7**
Extreme Maximum Temperature (°C)	11.7	14.4	23.3	30.6	134.4	36.7	39.5	37.2	33.9	26.0	20.0	14.5	39.5
Extreme Minimum Temperature (°C)	-25.0	-22.0	-17.8	-6.7	-3.9	0.6	5.6	5.6	-2.2	-5.6	-18.3	-25.6	-25.6
Rainfall (mm)	15.9	19.9	20.1	20.0	32.5	30.8	19.3	26.9	18.4	17.1	22.2	22.8	265.9
Snowfall (cm)	25.2	9.7	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	7.8	24.1	69.4
Total Precipitation (mm)	**41.2**	**30.0**	**22.5**	**20.0**	**32.5**	**30.8**	**19.3**	**26.9**	**18.4**	**17.3**	**30.0**	**46.8**	**335.7**
Greatest Rainfall in 24 hours (mm)	21.1	24.1	17.8	18.8	39.1	27.4	30.2	19.3	28.4	23.6	16.5	22.9	39.1
Greatest Snowfall in 24 hours (cm)	22.9	34.0	14.7	T	0.0	0.0	0.0	0.0	0.0	3.8	15.7	25.4	34.0
Greatest Precipitation in 24 hours (mm)	22.9	40.9	17.8	18.8	39.1	27.4	30.2	19.3	28.4	23.6	16.5	25.4	40.9
Days with Rain	4	5	6	6	7	7	5	6	5	6	7	6	70
Days with Snow	7	3	1	0	0	0	0	0	0	0	2	6	19
Days with Precipitation	10	8	7	6	7	7	5	6	5	6	9	11	87

Freeze Free Period: 180 days

Average date of last spring freeze: April 18
Average date of first autumn freeze: October 16

APPENDIX A (continued)

OLIVER 49° 10'N 119° 33'W 305 m	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Daily Maximum Temperature (°C)	-0.3	4.4	10.2	16.8	21.8	25.3	29.2	27.9	22.6	15.0	6.3	1.6	15.1
Daily Minimum Temperature (°C)	-6.9	-4.1	-2.0	1.8	6.2	10.2	12.1	11.4	6.6	1.6	-1.7	-4.3	2.6
Daily Temperature (°C)	**-3.6**	**0.2**	**4.1**	**9.4**	**14.1**	**17.8**	**20.7**	**19.7**	**14.7**	**8.4**	**2.4**	**1.4**	**8.9**
Extreme Maximum Temperature (°C)	15.0	16.7	22.8	30.6	35.0	37.2	42.8	39.4	36.1	29.4	20.0	15.6	42.8
Extreme Minimum Temperature (°C)	-30.6	-30.6	-22.2	-8.3	-7.8	-0.6	2.8	2.8	-4.4	-9.4	-20.6	-28.3	-30.6
Rainfall (mm)	12.2	14.4	17.0	19.5	29.7	25.6	18.1	27.3	17.1	16.8	19.1	18.2	235.0
Snowfall (cm)	19.3	8.6	2.4	T	0.0	0.0	0.0	0.0	0.0	0.1	6.4	18.9	55.7
Total Precipitation (mm)	**31.5**	**23.0**	**19.4**	**19.5**	**29.7**	**25.6**	**18.1**	**27.3**	**17.1**	**16.9**	**25.5**	**37.1**	**290.7**
Greatest Rainfall in 24 hours (mm)	20.3	13.2	12.7	16.8	50.8	20.6	27.4	26.4	23.4	16.3	19.6	19.6	50.8
Greatest Snowfall in 24 hours (cm)	14.2	30.5	8.4	T	T	0.0	0.0	0.0	0.0	1.5	13.7	19.8	30.5
Greatest Precipitation in 24 hours (mm)	21.8	33.5	13.5	16.8	50.8	20.6	27.4	26.4	23.4	16.3	19.6	24.9	50.8
Days with Rain	4	5	6	6	7	7	5	7	5	6	7	5	70
Days with Snow	7	3	1	0	0	0	0	0	0	0	2	6	19
Days with Precipitation	10	8	7	6	7	7	5	7	5	6	8	10	86

Freeze Free Period: 139 days

Average date of last spring freeze: May 11
Average date of first autumn freeze: September 28

PENTICTON AIRPORT 49° 28'N 119° 36'W 344 m	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Daily Maximum Temperature (°C)	-0.1	4.1	9.1	15.4	20.6	24.6	28.6	27.4	21.8	14.5	6.3	2.1	14.5
Daily Minimum Temperature (°C)	-5.3	-3.0	-1.4	1.8	6.1	9.8	12.0	11.6	7.6	3.0	-0.4	-2.9	3.2
Daily Temperature (°C)	**-2.7**	**0.6**	**3.9**	**8.6**	**13.4**	**17.2**	**20.3**	**19.5**	**14.7**	**8.7**	**3.0**	**-0.4**	**8.9**
Extreme Maximum Temperature (°C)	13.3	15.6	21.7	28.9	32.2	36.7	40.6	38.9	34.4	28.9	19.4	14.4	40.6
Extreme Minimum Temperature (°C)	-26.7	-26.7	-17.8	-7.2	-5.6	0.0	2.2	2.9	-2.8	-7.8	-18.9	-27.2	-27.2
Rainfall (mm)	8.2	9.9	13.1	21.0	29.1	27.6	21.1	26.5	17.7	15.2	16.8	11.5	217.7
Snowfall (cm)	29.0	11.4	4.4	0.2	T	0.0	0.0	0.0	0.0	0.2	7.7	23.1	76.0
Total Precipitation (mm)	**32.0**	**19.8**	**17.3**	**21.4**	**29.1**	**27.6**	**21.1**	**26.5**	**17.7**	**15.3**	**23.9**	**31.2**	**282.9**
Greatest Rainfall in 24 hours (mm)	15.7	18.5	16.3	27.4	29.7	33.5	37.8	23.6	28.1	44.5	19.3	12.4	44.5
Greatest Snowfall in 24 hours (cm)	19.6	23.1	10.0	4.1	T	T	0.0	0.0	T	2.0	20.6	22.1	23.1
Greatest Precipitation in 24 hours (mm)	16.0	18.5	16.3	27.4	29.7	33.5	37.8	23.6	28.1	44.5	19.3	22.1	44.5
Days with Rain	4	5	6	6	9	8	6	7	7	7	7	6	78
Days with Snow	11	5	2	0	0	0	0	0	0	T	3	8	29
Days with Precipitation	13	9	7	6	9	8	6	7	7	7	9	12	100

Freeze Free Period: 148 days

Average date of last spring freeze: May 8
Average date of first autumn freeze: October 4

SUMMERLAND 49° 34'N 119° 39'W 454 m	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Daily Maximum Temperature (°C)	-0.5	3.6	8.3	14.4	19.7	23.7	27.8	26.5	20.9	13.5	5.6	1.6	13.8
Daily Minimum Temperature (°C)	-6.3	-3.4	-0.9	2.9	7.3	11.1	13.9	13.5	9.5	4.4	-0.6	-3.8	4.0
Daily Temperature (°C)	**-3.4**	**0.1**	**3.7**	**8.7**	**13.5**	**17.4**	**20.9**	**20.0**	**15.2**	**9.0**	**2.5**	**-1.1**	**8.9**
Extreme Maximum Temperature (°C)	13.9	16.7	22.2	28.9	33.9	38.3	40.0	37.8	34.4	28.5	18.9	15.6	40.0
Extreme Minimum Temperature (°C)	-30.0	-26.7	-21.7	-10.0	-5.0	1.7	4.4	5.5	-3.9	-9.4	-18.9	-29.4	30.0
Rainfall (mm)	5.7	7.2	10.9	19.5	27.5	30.6	22.2	27.4	18.8	17.3	17.0	9.4	213.5
Snowfall (cm)	29.9	11.6	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.3	8.5	23.4	77.7
Total Precipitation (mm)	**35.6**	**18.8**	**14.8**	**19.6**	**27.5**	**30.6**	**22.2**	**27.4**	**18.8**	**17.6**	**25.4**	**32.8**	**291.1**
Greatest Rainfall in 24 hours (mm)	12.2	9.7	13.2	25.4	26.7	34.0	41.7	21.8	23.1	45.5	18.0	22.9	45.5
Greatest Snowfall in 24 hours (cm)	19.1	30.5	33.5	5.1	0.0	0.0	0.0	0.0	0.0	12.7	19.8	45.7	45.7
Greatest Precipitation in 24 hours (mm)	19.1	30.5	33.5	25.4	26.7	34.0	41.7	21.8	23.1	45.5	19.8	45.7	45.7
Days with Rain	3	4	5	6	9	9	6	7	7	7	7	5	75
Days with Snow	10	5	2	0	0	0	0	0	0	0	3	8	28
Days with Precipitation	12	8	7	6	9	9	6	7	7	7	10	12	100

Freeze Free Period: 165 days

Average date of last spring freeze: April 27
Average date of first autumn freeze: October 10

APPENDIX A (continued)

KELOWNA AIRPORT 49° 58'N 119° 23'W 429 m	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Daily Maximum Temperature (°C)	-1.0	3.3	8.3	14.9	20.3	24.1	28.0	26.7	21.0	13.5	5.4	1.2	13.8
Daily Minimum Temperature (°C)	-9.3	-6.3	-3.6	0.0	4.2	7.8	9.3	8.9	5.2	0.5	-3.3	-6.3	0.6
Daily Temperature (°C)	**-5.1**	**-1.6**	**2.3**	**7.5**	**12.2**	**15.9**	**18.7**	**17.8**	**13.1**	**6.9**	**1.1**	**-2.5**	**7.2**
Extreme Maximum Temperature (°C)	11.1	14.4	18.3	27.6	31.1	35.6	38.6	38.3	32.2	26.3	20.6	14.5	38.6
Extreme Minimum Temperature (°C)	-31.7	-25.0	-19.5	-8.9	-3.3	-0.6	2.6	0.6	-6.1	-11.7	-18.9	-36.1	-36.1
Rainfall (mm)	6.6	8.7	12.7	17.4	28.0	26.1	24.1	30.8	29.3	18.6	13.4	9.9	226.4
Snowfall (cm)	31.6	15.0	6.3	0.3	0.0	0.0	0.0	0.0	0.0	0.6	11.6	38.1	103.5
Total Precipitation (mm)	**30.7**	**21.0**	**18.6**	**17.7**	**28.0**	**26.9**	**24.1**	**30.8**	**29.3**	**19.0**	**24.2**	**42.1**	**312.4**
Greatest Rainfall in 24 hours (mm)	9.7	4.8	13.7	12.2	20.8	16.5	21.1	19.6	22.4	18.3	13.2	14.2	22.4
Greatest Snowfall in 24 hours (cm)	21.8	19.1	9.4	1.3	T	0.0	0.0	0.0	0.0	6.9	14.5	19.3	21.8
Greatest Precipitation in 24 hours (mm)	16.1	16.0	13.7	12.2	20.8	16.5	21.1	19.6	22.4	19.3	15.8	14.2	22.4
Days with Rain	3	5	7	7	9	10	7	8	8	8	8	4	84
Days with Snow	13	6	3	0	0	0	0	0	0	1	5	10	38
Days with Precipitation	15	11	10	7	9	11	8	8	8	9	12	15	123

Freeze Free Period: 116 days

Average date of last spring freeze: May 26
Average date of first autumn freeze: September 20

OKANAGAN CENTRE 50° 4'N 119° 27'W 347 m	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YEAR
Daily Maximum Temperature (°C)	0.1	3.8	8.0	14.2	19.7	23.6	27.3	26.3	20.7	13.6	6.0	2.2	13.8
Daily Minimum Temperature (°C)	-5.5	-3.3	-1.7	1.8	6.1	10.1	12.2	11.9	8.3	3.9	-0.6	-3.2	3.3
Daily Temperature (°C)	**-2.7**	**0.3**	**3.2**	**8.1**	**12.9**	**16.9**	**19.8**	**19.1**	**14.6**	**8.8**	**2.8**	**-0.5**	**8.6**
Extreme Maximum Temperature (°C)	12.8	17.2	21.1	28.9	32.8	35.6	40.0	36.1	33.9	30.6	20.6	15.6	40.0
Extreme Minimum Temperature (°C)	-30.0	-25.6	-22.8	-7.8	-3.9	1.1	1.7	2.8	-1.1	-11.7	-20.0	-28.3	-30.0
Rainfall (mm)	11.5	14.1	17.3	18.4	26.9	29.3	27.2	34.0	30.4	24.6	24.2	16.4	274.3
Snowfall (cm)	29.9	12.2	4.6	0.3	0.0	0.0	0.0	0.0	0.0	0.1	8.4	25.3	80.8
Total Precipitation (mm)	**41.8**	**26.3**	**21.9**	**18.7**	**26.9**	**29.3**	**27.2**	**34.0**	**30.4**	**24.7**	**32.6**	**41.7**	**355.5**
Greatest Rainfall in 24 hours (mm)	35.1	17.8	14.7	33.8	22.4	24.9	43.7	32.0	27.7	29.5	24.8	24.9	43.7
Greatest Snowfall in 24 hours (cm)	36.8	40.6	15.7	8.9	0.0	0.0	0.0	0.0	0.0	5.1	16.5	31.8	40.6
Greatest Precipitation in 24 hours (mm)	36.8	40.6	15.7	33.8	22.4	24.9	43.7	32.0	27.7	29.5	24.8	31.8	43.7
Days with Rain	3	5	7	6	9	9	6	8	8	9	8	6	84
Days with Snow	8	4	1	0	0	0	0	0	0	0	2	6	21
Days with Precipitation	11	8	8	6	9	9	6	8	8	9	10	11	103

Freeze Free Period: 173 days

Average date of last spring freeze: April 26
Average date of first autumn freeze: October 17

APPENDIX B

METHODOLOGY FOR DERIVING GRAPE PRODUCTION SUITABILITY CLASSES

The grape production suitability maps are based on a combination of soils and climatic suitability information. Four soils suitability classes are described in Table 27. Four climatic suitability classes were developed based on a blending of the three mapped themes. The result was a matrix with 64 possible combinations (Table B-1) composed of 4 growing degree day (G.D.D.) classes, 4 autumn freeze (Freeze) classes and 4 solar radiation (Solar) classes. The ratings that were given to the climatic parameters were determined subjectively based on experience and grape production at selected benchmark locations.

For example, the area near Gartrell Point (at the Mouth of Trout Creek near Summerland) has been given a Class 2 climatic suitability based on a Class 3 growing degree day accumulation, Class 1 freeze risk and a Class 2 solar radiation. Similarly, the area near Inkameep Provincial Park is Class 2 but has a Class 2 growing degree day accumulation, a Class 2 freeze risk and a Class 1 solar radiation.

The final suitability maps were prepared by developing a rating system based on the soil and climatic suitability. The soil suitability classes 1, 2, and 4 are the same as those described in Table 27. Class 3 soils, made up of soil groups 10 and 11, have been divided into soils with marginal suitability for viticulture (group 10) and soils presently unsuitable for commercial grape production (group 11). The result was 5 soil classes of which 3 are suitable for viticulture and 2 are unsuitable.

Finally, a matrix with 20 possible combinations, the product of 4 climatic suitability classes and 5 soil suitability classes, was developed (Table B-2). Five overall suitability classes were assigned to the various component parts of the matrix. These ratings were determined subjectively based on experience and selected grape productiton information. For example, a Class 2 grape site suitability class exists in the lake front area near Okanagan Mission (Kelowna) a result of a Class 1 soil suitability and a Class 3 climatic suitability. Similarly, Inkameep Provincial Park has a Class 2 grape site suitability a result of the combination of a Class 2 soil and Class 2 climate.

As a note of caution it must be stated that these two matrices were developed specifically for the Okanagan and Similkameen Valleys and attempts should not be made to transfer these groupings to other areas without careful study.

Table B.1

GROWING DEGREE DAYS AUTUMN FREEZE RISK SOLAR RADIATION			
1•1•1	1•1•2	1•1•3	1•1•4
1•2•1	1•2•2	1•2•3	1•2•4
1•3•1	1•3•2	1•3•3	1•3•4
1•4•1	1•4•2	1•4•3	1•4•4
2•1•1	2•1•2	2•1•3	2•1•4
2•2•1	2•2•2	2•2•3	2•2•4
2•3•1	2•3•2	2•3•3	2•3•4
2•4•1	2•4•2	2•4•3	2•4•4
3•1•1	3•1•2	3•1•3	3•1•4
3•2•1	3•2•2	3•2•3	3•2•4
3•3•1	3•3•2	3•3•3	3•3•4
3•4•1	3•4•2	3•4•3	3•4•4
4•1•1	4•1•2	4•1•3	4•1•4
4•2•1	4•2•2	4•2•3	4•2•4
4•3•1	4•3•2	4•3•3	4•3•4
4•4•1	4•4•2	4•4•3	4•4•4

Table B.2

SOILS CLIMATE				
1 • 1	2 • 1	3 • 1	3 • 1	4 • 1
1 • 2	2 • 2	3 • 2	3 • 2	4 • 2
1 • 3	2 • 3	3 • 3	3 • 3	4 • 3
1 • 4	2 • 4	3 • 4	3 • 4	4 • 4

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